SIEMENS

POLYDOROS SX 50/80

RX

Generator

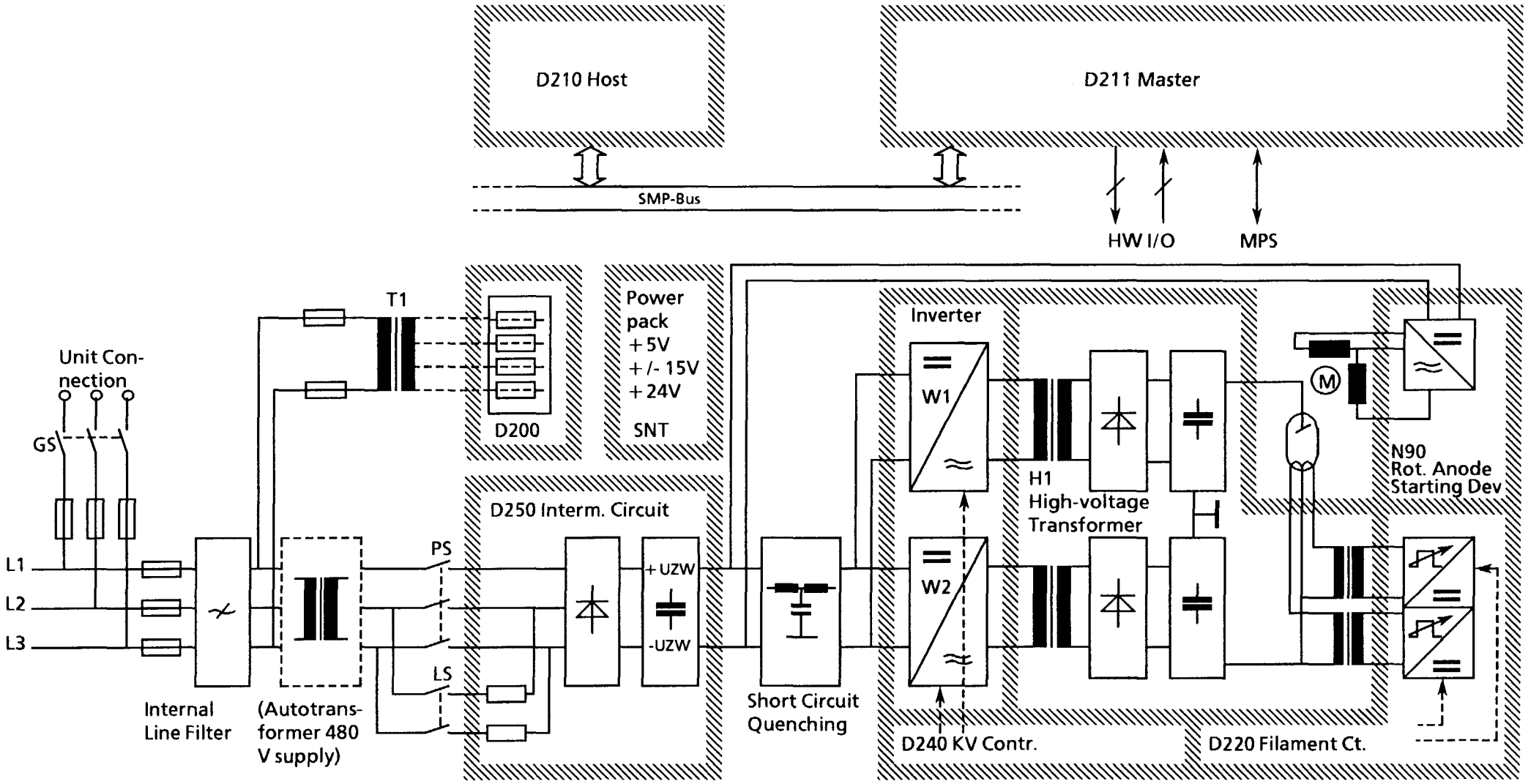
Function Description X2075

Register 7

RX63-050.041.01.01.02 Englisch

Replaces: 03.94

Contents


D210 Host
D211 Master
SMP-Bus
HW I/O
MPS
T1
D200
Power pack
+5V
+/- 15V
+24V
SNT
Inverter
W1
W2
H1
High-voltage Transformer
N90
Rot. Anode Starting Dev
Unit Con-nection
GS
L1
L2
L3
PS
LS
D250 Interm. Circuit
+UZW
-UZW
Short Circuit Quenching
Internal Line Filter
(Autotrans-former 480 V supply)
D240 KV Contr.
D220 Filament Ct.

The power line voltage is transmitted from terminals L1, L2 and L3, via the integrated RF suppression filter to the Intermediate Circuit. The maximum permissible input voltage here is 400 V. Connection to 440 V and 480 V power supplies therefore requires an autotransformer ahead of the Intermediate Circuit.

Rectification and smoothing of the input voltage are performed in the Intermediate Circuit. The Intermediate Circuit voltage +/ - UZW serves as the supply to the Main Inverter W1 and the Rotating Anode Starting Device N90.

The Main Inverter comprises two inverters with relative time offset, for the separate feeding of the plus and minus sides of the High-voltage Transformer. The Short Circuit Quenching is found between the Intermediate DC Circuit and the Inverter.

The Inverter control signals and high-voltage switching derive from the kV Controller (D240).

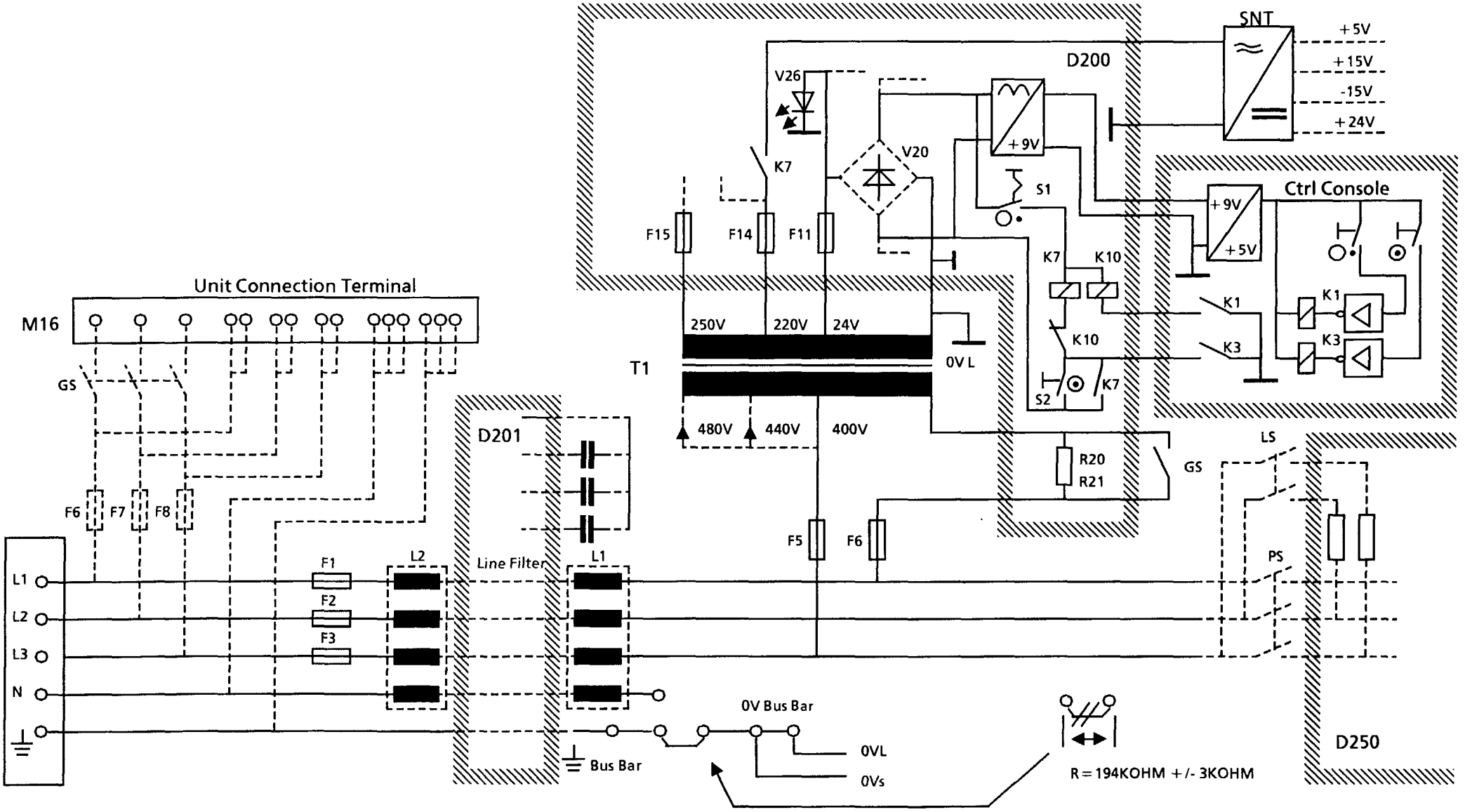
The x-ray tube filament current is also generated by inverters, in the Filament Circuit (D220). These inverters control the power level by pulse width modulation.

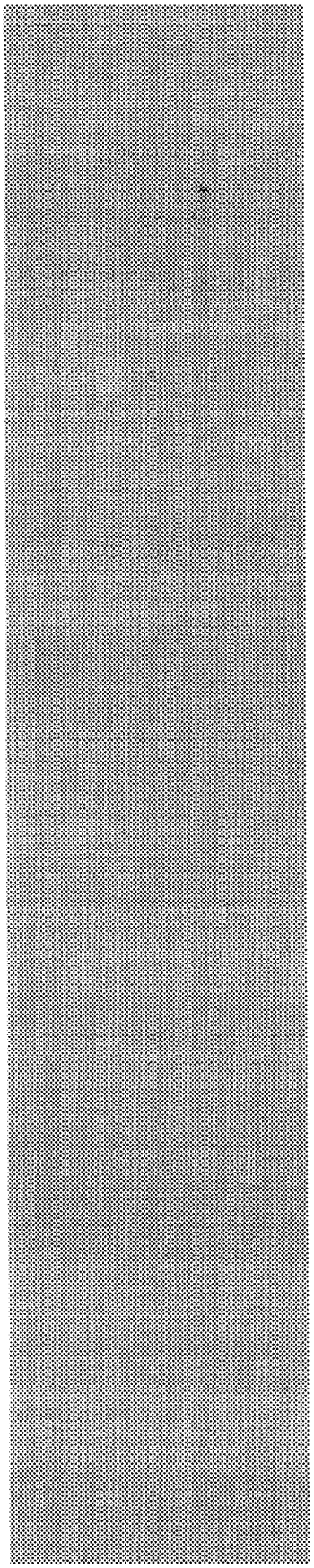
The Starting Device N90 drives the rotating anode. This also includes an inverter, which generates the frequencies required. Control of the power level is again by means of pulse width modulation.

Transformer T1, which supplies current internally, is connected to the outer phases L1 and L2. The secondary voltages are transmitted via fuses and a rectifier to the power pack SNT. The +5 V and +/ -15 V DC voltages for the electronics and the +24 V DC voltage supply to various relays are generated here.

The Host Computer D210 controls the generator. Via the Master board D211, this is able to access the various generator components. This makes use of parallel hardware I/O ports and also the MPS serial interface

Power input circuit, On/Off switch circuit





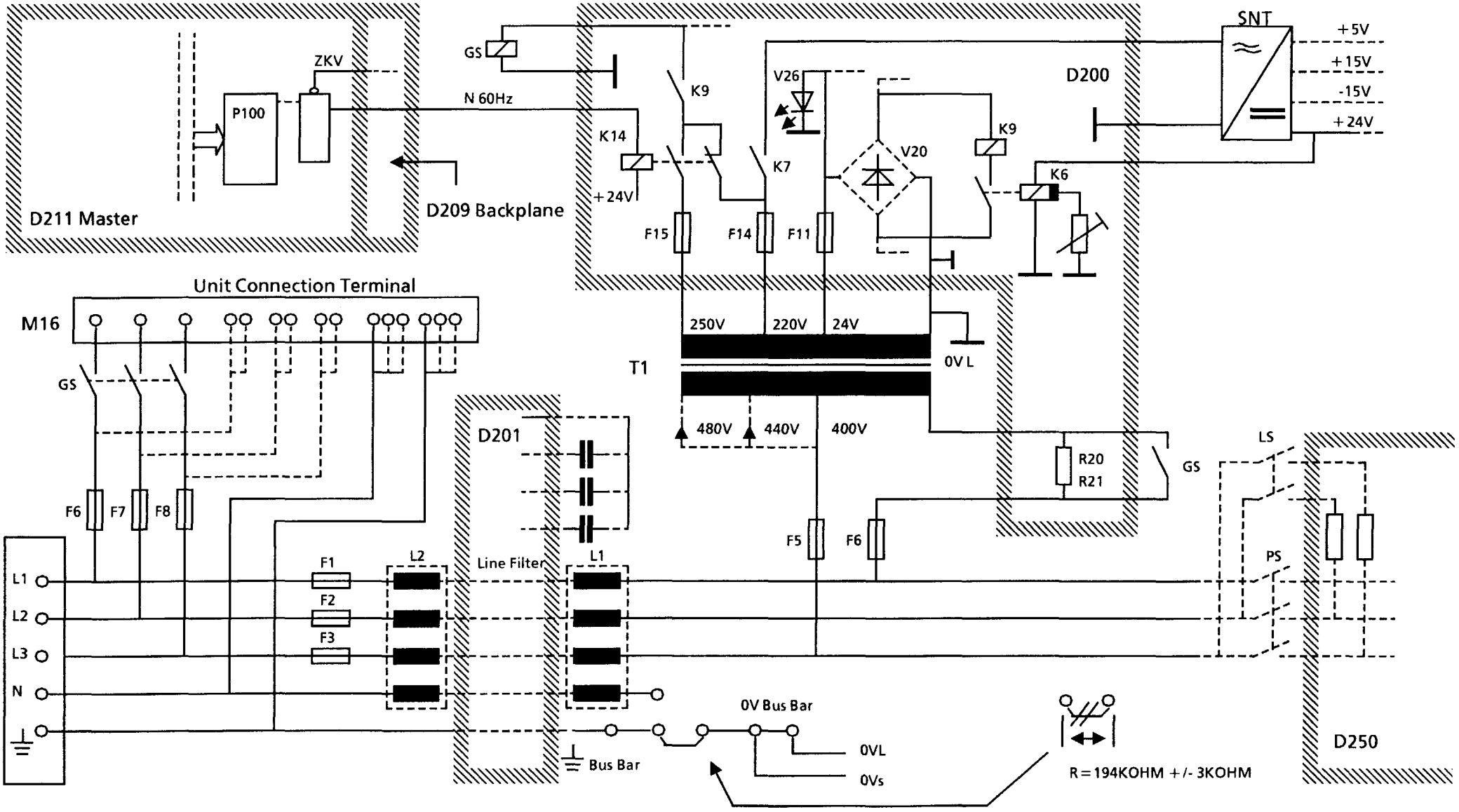
The generator power connection is via terminals L1, L2, L3 und N. The permissible power line voltages are 400 V, 440 V and 480 V. Connection to 440 V and 480V lines requires an autotransformer (T4) between the RF suppression filter integrated into the power cabinet and the Intermediate Circuit. The autotransformer T4 generates 400 V from the 440 V or 480 V line input.

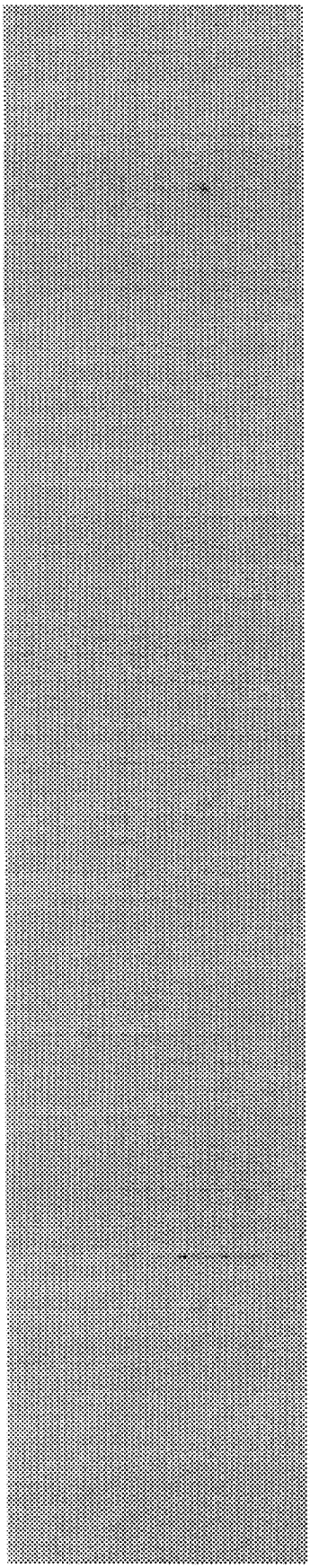
Transformer T1 is connected to the outer phases L1 and L3 for the generation of the auxiliary voltages. Connection depends on the available line voltage. The resistors R20 / R21 limit the current during switch-on of the system contactor. Following switch-on, these are short circuited to the GS contactor.

The system is switched on from the ON key on the control panel. Via relay K3, this actuates the switch-on relay K7 in Safety Circuit D200. K7 is then energized. Via K7, voltage is applied to the power pack SNT for generation of the +5 V, +/ – 15 V and +24 V DC voltages. The +24 V actuates other relays to switch through various auxiliary voltages (not shown).

Actuating the switch-off key on the Control Console actuates relay K1 and in turn relay K10, deenergizing K7.

For servicing, it is also possible to switch on the system with pushbutton S2 and switch off the system with pushbutton S1, in Safety Circuit D200. While S1 is active, switch-on from the control console is disabled

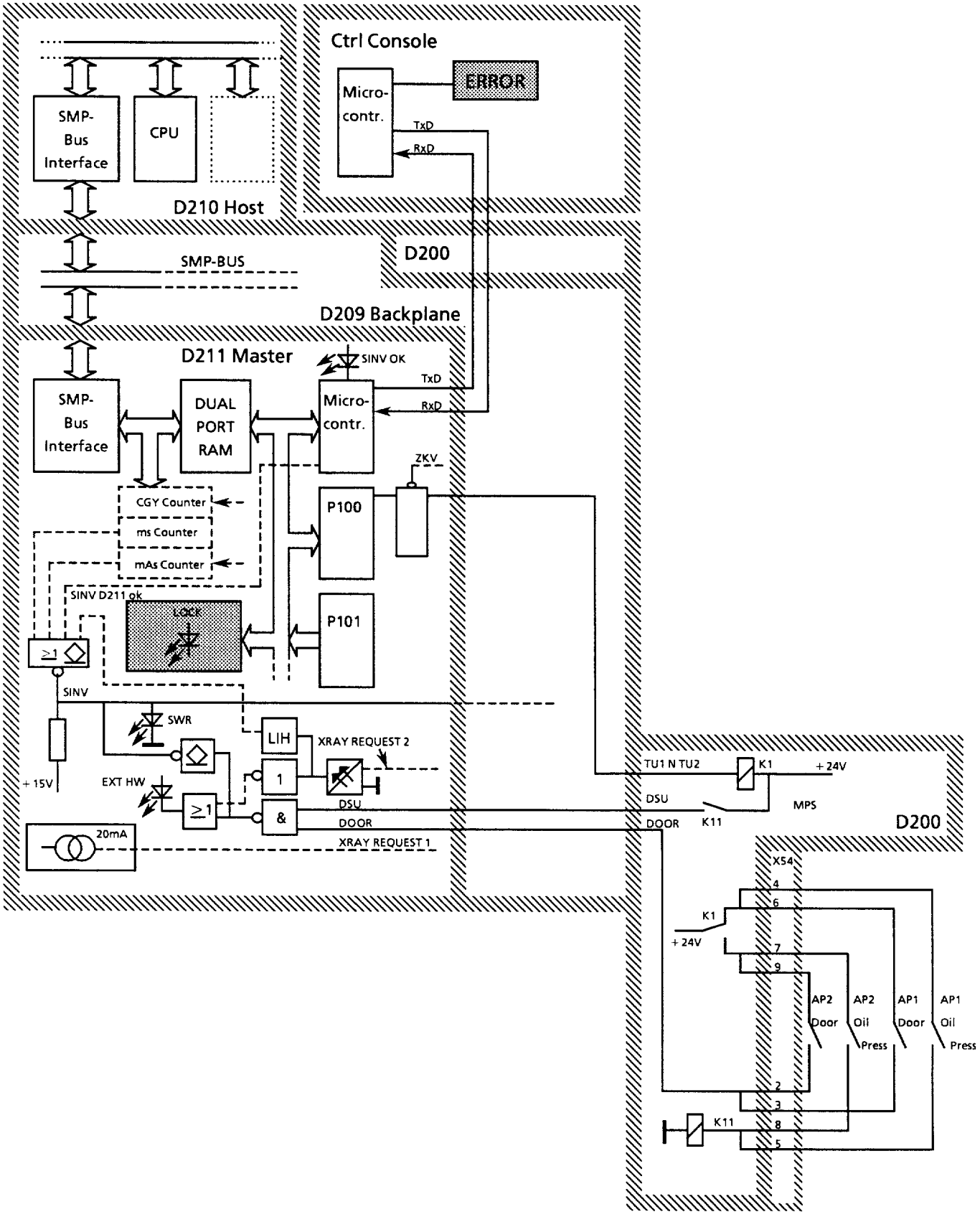

D211 Master
ZKV
P100
GS
N 60Hz
D209 Backplane
K14
+24V
K9
K7
V26
V20
K9
K6
F15
F14
F11
D200
SNT
+5V
+15V
-15V
+24V
250V
220V
24V
0V L
T1
480V
440V
400V
Unit Connection Terminal
M16
GS
F6
F7
F8
D201
F1
F2
F3
L2
Line Filter
L1
F5
F6
R20
R21
GS
LS
PS
L1
L2
L3
N
0V Bus Bar
Bus Bar
0VL
0Vs
R=194KOHM +/- 3KOHM
D250

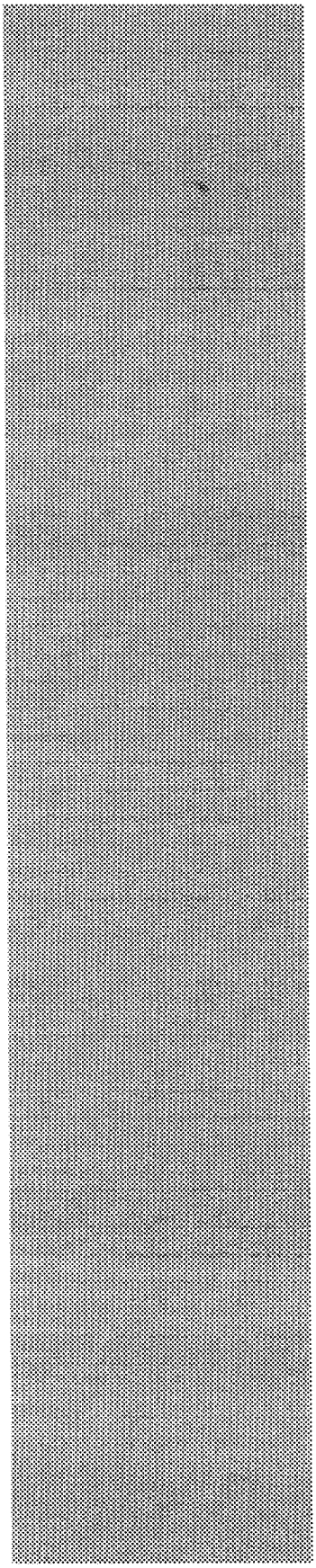


Terminals M 16.K1 are available for connecting the system components and the I.I.-TV. Switch-on is via the GS contactor. Control is via Generator On (K7), time-lag relay K6 and relay K9.

The time-lag relay K6 delays switch-off, so that during short periods of generator switch-off there is still power to the external components.

The GS contactor power is switched by relay K14 and depends on the line frequency (50 Hz/220 V or 60 Hz/250 V).
With 60 Hz, the Host Computer outputs the signal N_60 Hz via port P100 on the Master board.


Ctrl Console
Micro-contr.
ERROR
TxD
RxD
SMP-Bus Interface
CPU
D210 Host
SMP-BUS
D200
D209 Backplane
D211 Master
SINV OK
TxD
RxD
SMP-Bus Interface
DUAL PORT RAM
Micro-contr.
ZKV
CGY Counter
ms Counter
mAs Counter
P100
P101
SINV D211 ok
LOCK
≥1
SINV
SWR
LIH
XRAY REQUEST 2
+ 15V
EXT HW
1
≥1
&
DSU
DOOR
XRAY REQUEST 1
20mA
TU1 N TU2
K1
+ 24V
DSU
MPS
DOOR
K11
D200
X54
4
6
K1
+ 24V
7
9
AP2 Door
AP2 Oil Press
AP1 Door
AP1 Oil Press
2
3
K11
8
5



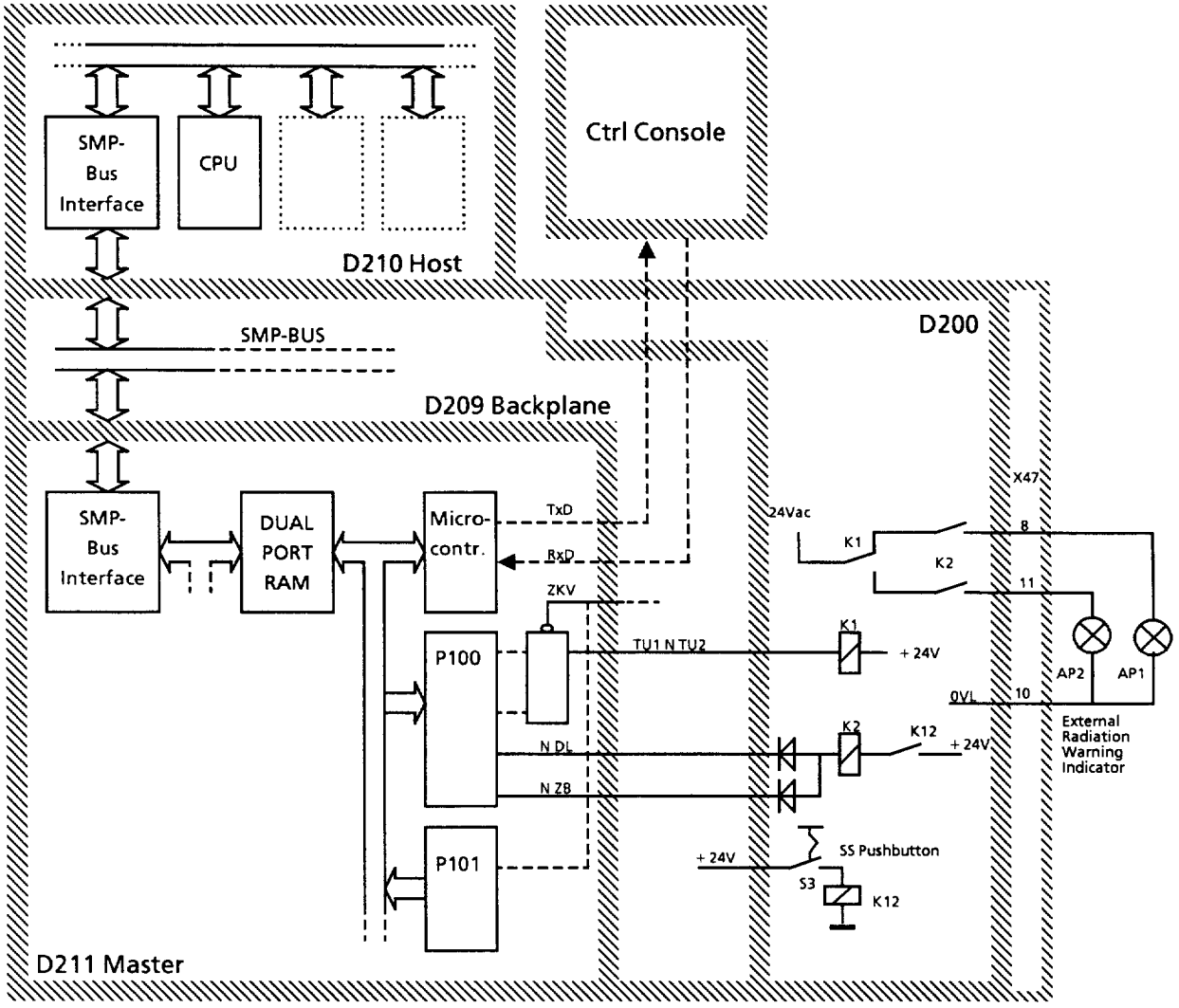
DVia plug X54, D200 it is possible to make use of hardware, such as a door contact, to disable radiation release.

Tubes can be connected to give one or two tubes in a single room or two tubes in two rooms. *4 and *5 on sheet 12 of the generator wiring diagram explain the connections.

If the tubes are equipped with oil pressure switches, connect these to X54, D200 also.

Either of the disable functions, Door Open (Door) or Oil Pressure Switch Open (DSU), causes the signal SINV to disable or switch off the high voltage. The signals are transmitted via port P101 to the Host Computer for evaluation.

The status of the Door and DSU signals is indicated on LED EXTHW, D211. Generator disabling is indicated on the red LED LOOK, D211 and also on the deck, for the operator.


SMP-
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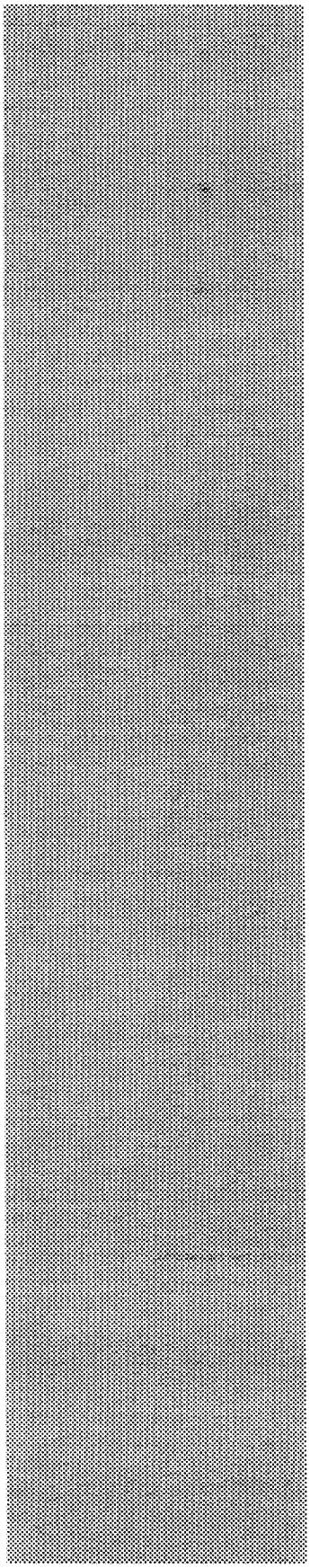
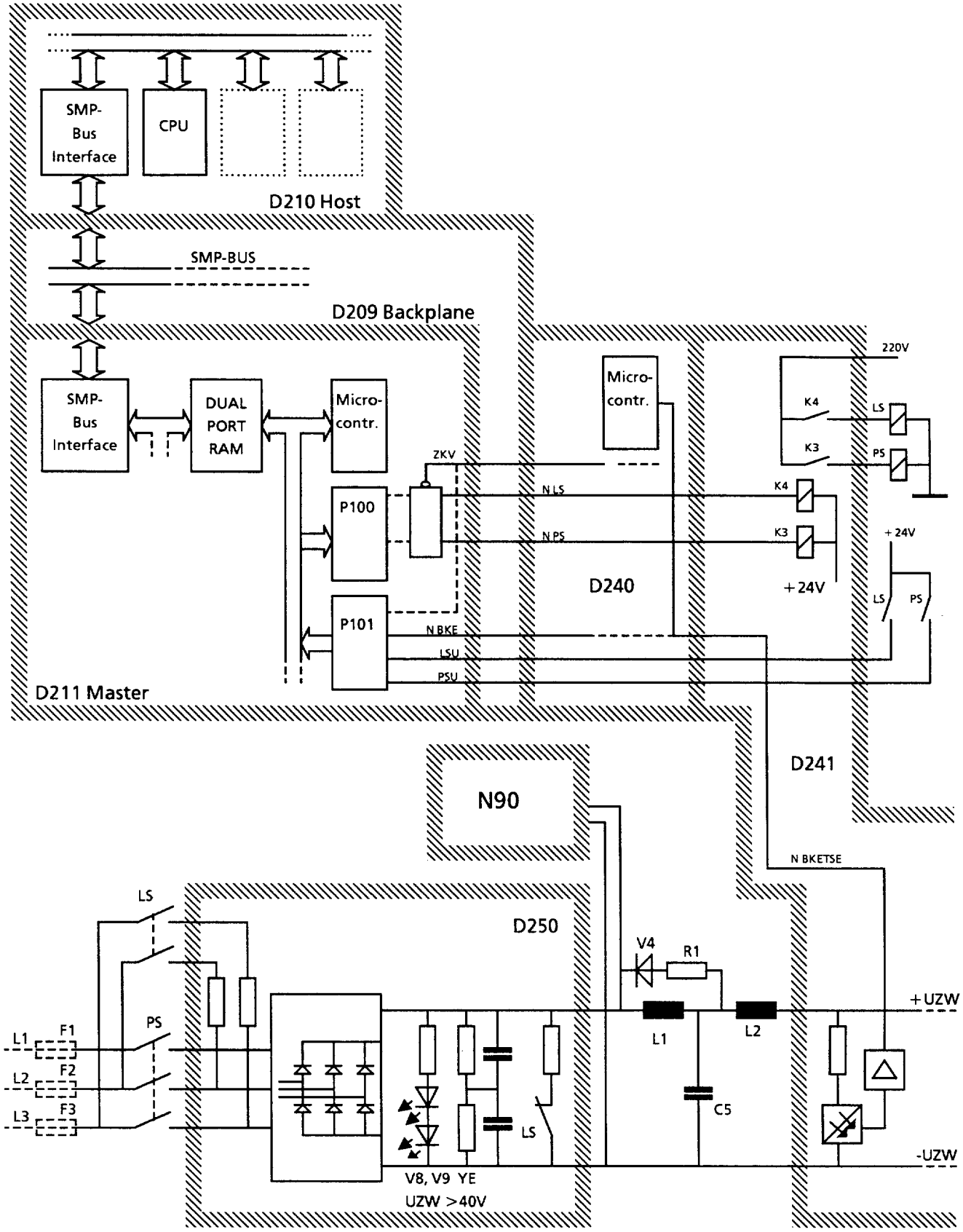
Interface
CPU
D210 Host
Ctrl Console
D200
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
TxD
RxD
ZKV
P100
P101
N DL
N ZB
TU1 N TU2
X47
24Vac
K1
K2
8
11
+ 24V
AP2
AP1
0VL
10
External
Radiation
Warning
Indicator
K12
SS Pushbutton
S3
D211 Master



It is possible to connect an external radiation warning indicator to plug X47, D200. 24 V AC are available. The current depends on the workstation (tube) selected and is
1 A maximum. During fluoroscopy or radiographic preparations, the indications are displayed only when SS Pushbutton S3 is pressed (radiation possible)


SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
ZKV
P100
P101
N LS
N PS
N BKE
LSU
PSU
D211 Master
Micro-
contr.
220V
K4
K3
LS
PS
K4
K3
+24V
D240
+24V
LS
PS
D241
N90
N BKETSE
LS
PS
L1
L2
L3
F1
F2
F3
D250
V4
R1
L1
L2
C5
LS
+UZW
-UZW
V8, V9 YE
UZW >40V

Following initialization of the Host Computer D210 and Master board D211, the Intermediate DC Voltage Circuit is switched on. This supplies the Main Inverter and also the inverter in the Rotating Anode Starting Device N90.

Because of the very high charging currents, switch-on takes place in two steps. In the first, the Intermediate Circuit capacitors are charged with the LS contactor, via a switch-on damping circuit. The signal N_BKETSE (N_BKE at port P101 on the Master board) monitors the charging process. When the Intermediate Circuit voltage reaches a value of > 40 V within 1.5 seconds, the PS contactor is switched on after another 3.5 seconds, bypassing the damping circuit.

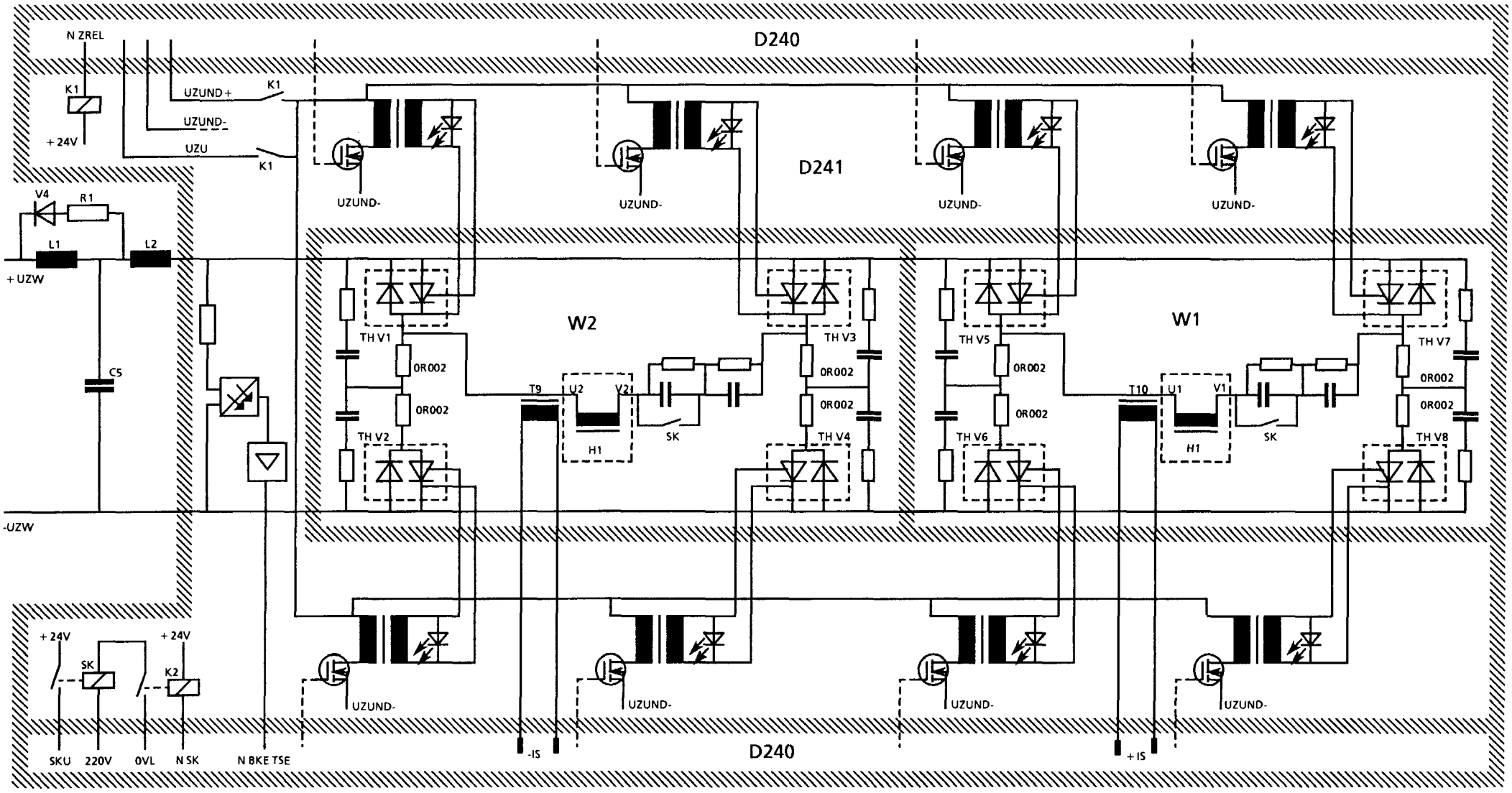
The charging state of the capacitors in the Intermediate Circuit is indicated on two yellow LEDs (V8 and V9 on D250).

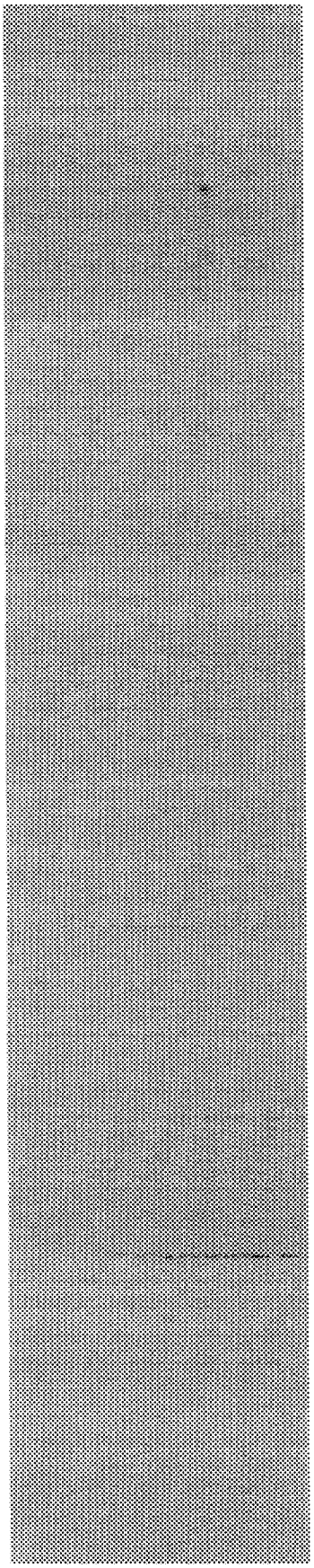
The LS contactor is switched via K4 by the signal N_LS and the PS contactor via K3 by the signal N_PS. During fluoroscopy and radiography, the signal ZKV (two kV threshold) disables N_LS and N_PS via hardware.

The status of the contactors LS and PS is also monitored by means of the LSU and PSU signals, read in from the Master board via port P101 and transmitted to the Host Computer for evaluation. If a fault is detected, the Intermediate Circuit is switched off and the appropriate error message is generated.

Switching off the generator initiates discharging of the Intermediate Circuit capacitors via an LS break contact.

The components L1, L2 and C5 comprise the automatic Short Circuit Quenching circuit (see Inverter for function description).


N ZREL
K1
+ 24V
UZUND+
UZUND-
UZU
K1
D240
D241
UZUND-
V4
R1
L1
L2
+ UZW
C5
W2
W1
TH V1
TH V2
TH V3
TH V4
TH V5
TH V6
TH V7
TH V8
0R002
T9
T10
U2
V2
U1
V1
H1
SK
-UZW
+ 24V
SK
K2
SKU
220V
0VL
N SK
N BKE TSE
-IS
+ IS
D240



Two inverters are used to generate the high voltage, one generating the positive side via u1, v1 and the other generating the negative side via u2, v2. Together, the inverters form a series oscillator inverter. The oscillating circuits are comprised of the leakage inductances of the High-voltage Transformers together with the capacitors in series. Each oscillation is initiated by the transmission of a control pulse of ca. 10 µs duration to the transistors of the ignition stages. Via the transformer which serves for potential segregation, this ignition pulse is transmitted to the thyristor pair. The control logic on D240 (kV Controller) determines the ignition sequence:

THV1 - THV4
THV5 - THV8
THV3 - THV2
THV7 - THV6

In order to obtain the least possible high-voltage ripple at low tube currents, the inverter output level is reduced by connecting the remaining capacitors in series to lower the oscillatory circuit capacitances. Switching takes place at < 100 mA with the SK contactor switched off.

Current transformers measure the oscillation currents, which can then be read at test points on D240 (see wiring diagram X2075, sheet 17, for oscillograms).

An RC combination is connected in parallel across each thyristor module (surge absorbing capacitor circuit). This serves to limit the off-state voltage rise (du/dt), ensuring disabling.

The green LEDs indicate the ignition pulses on the secondary side of the ignition transformer.

Control signals to the inverter:

N_ZREL.....Switches in the operating voltage for the ignition stages just before high-voltage enabling via K1

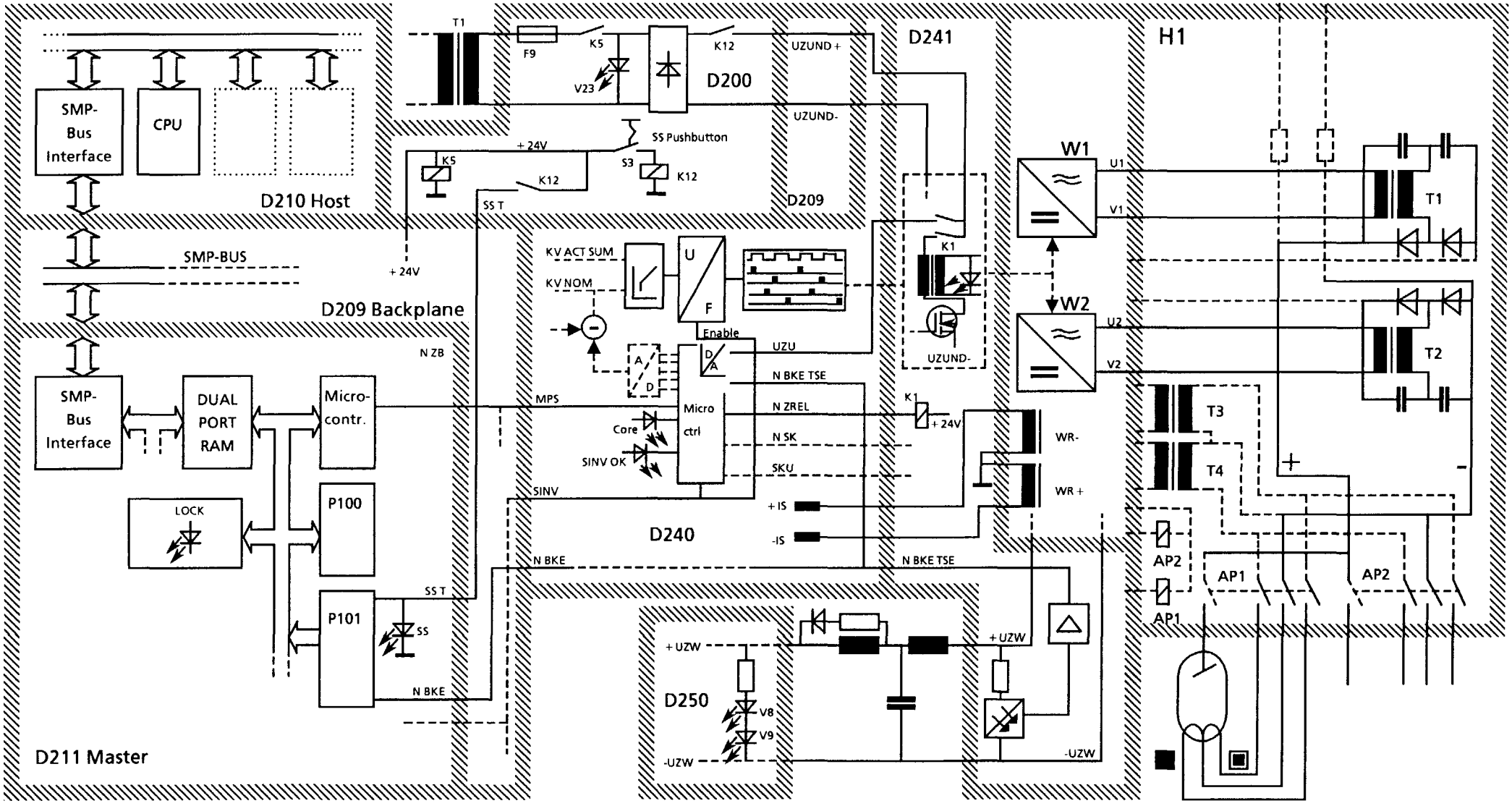
N_SK.....Oscillator circuit switchover: at ≥100 mA SK On

Decision feedback signals from inverter:

UZU.....Ignition stage operating voltage check signal

SKU.....SK contactor monitoring signal

N_BKETSE... Intermediate Circuit voltage check signal and bridge short circuit detection signal

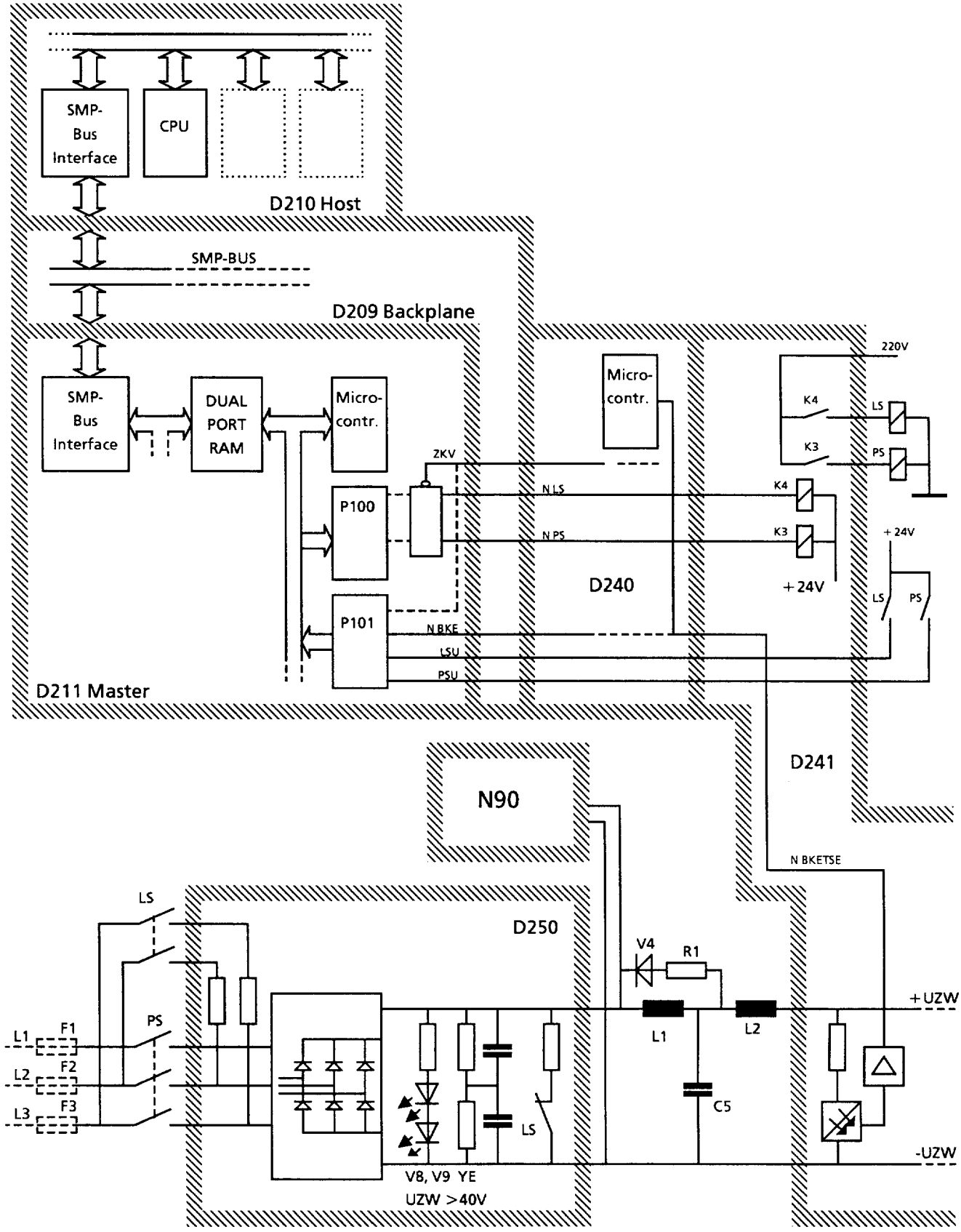

SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
LOCK
P100
P101
SS
N BKE
SS T
N ZB
MPS
SINV
D211 Master
T1
F9
K5
V23
K12
D200
UZUND+
UZUND-
+ 24V
SS Pushbutton
S3
K12
K5
K12
SS T
D209
+ 24V
KV ACT SUM
KV NOM
U
F
Enable
UZU
N BKE TSE
N ZREL
N SK
SKU
Micro
ctrl
Core
SINV OK
+IS
-IS
D240
N BKE
N BKE TSE
D241
K1
UZUND-
+UZW
D250
V8
V9
-UZW
+UZW
-UZW
H1
W1
W2
U1
V1
U2
V2
K1
+ 24V
WR-
WR+
T1
T2
T3
T4
AP2
AP1
AP1
AP2

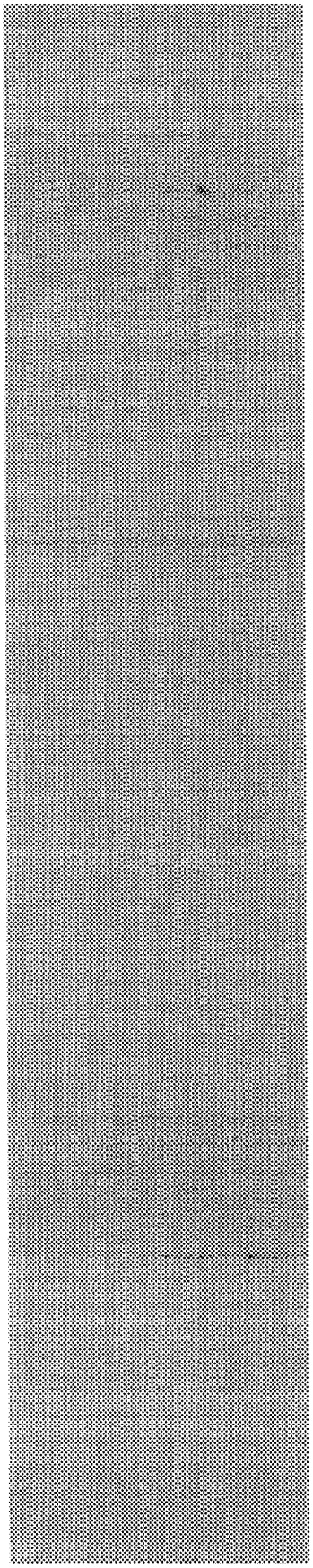
The analog corrective signal of the kV Controller is transformed by a voltage frequency converter to generate an output signal with four times the inverter frequency. Logic circuitry distributes this signal to the ignition stages of the inverter bridges and determines the ignition sequence

Via N_ZREL (D240) and K1 (D241), the operating voltage for the ignition stages is switched on just before the high-voltage enable. The Microcontroller checks this via UZU. The ignition voltage is now present, as long as it has not been disabled by the SS function.

High-voltage switch-on and switch-off take place via the SINV (Start/Stop INVerter) circuit, which also enables and disables the voltage frequency converter. The green "SINV" LED indicates the status of the SINV in the kV Controller (LED On: high voltage enabled).

The high voltage is disabled when the Intermediate Circuit voltage+/-UZW is less than 40 V. For this purpose, the signal N_BKE_TSE monitors the Intermediate Circuit. While the high voltage is enabled, the signal N_BKE_TSE serves for the detection of a bridge short circuit. In this case, all thyristors are first ignited (distributing the current over all the thyristors). The inverter is then disabled for 10 ms, permitting the Short Circuit Quenching to take place and preventing thermal overloading of the thyristors.


SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
ZKV
P100
P101
N LS
N PS
N BKE
LSU
PSU
D211 Master
Micro-
contr.
D240
220V
K4
K3
LS
PS
+24V
D241
N90
N BKETSE
D250
LS
PS
L1
L2
L3
F1
F2
F3
V4
R1
L1
L2
C5
LS
+UZW
-UZW
V8, V9 YE
UZW >40V

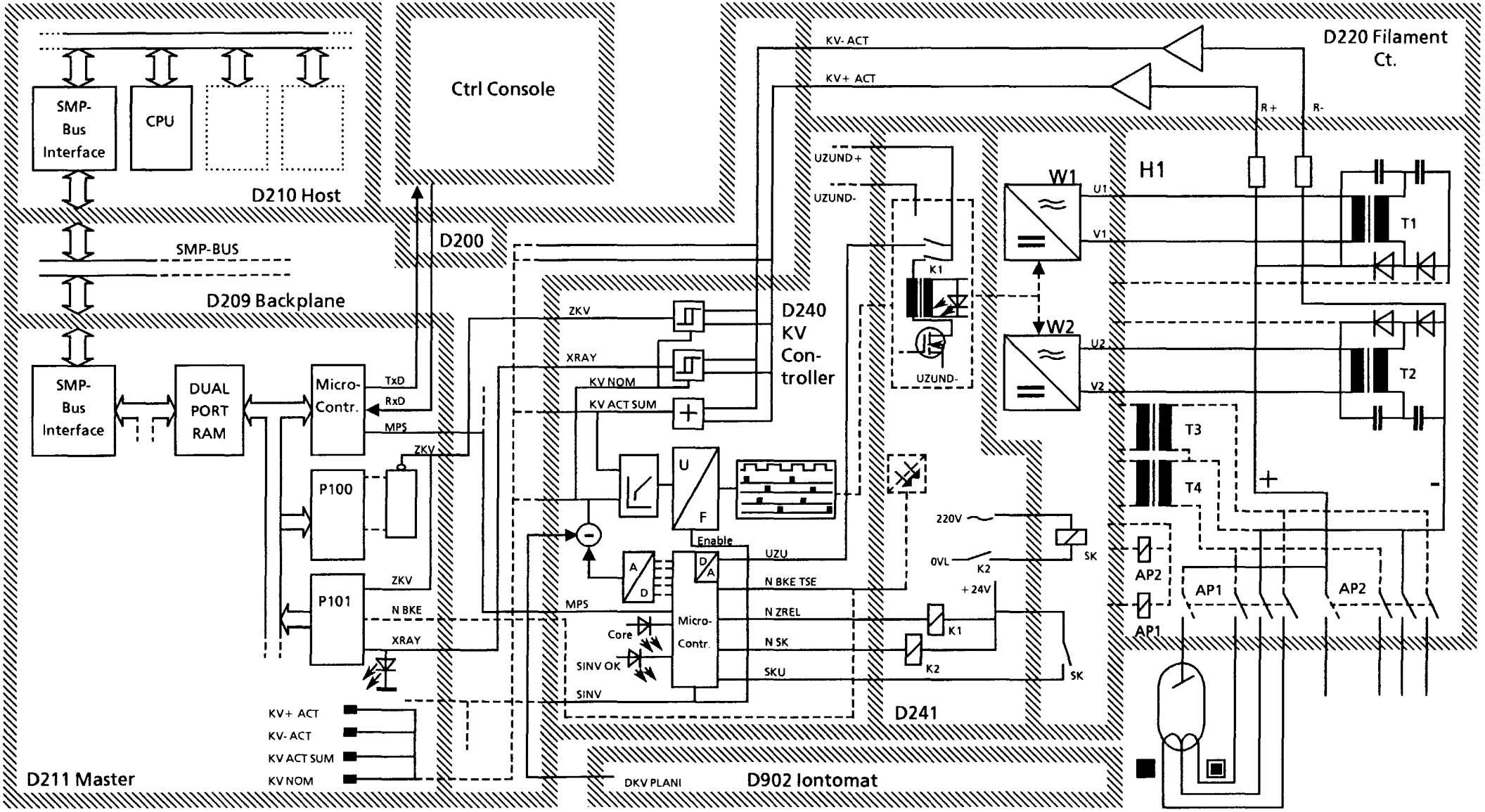


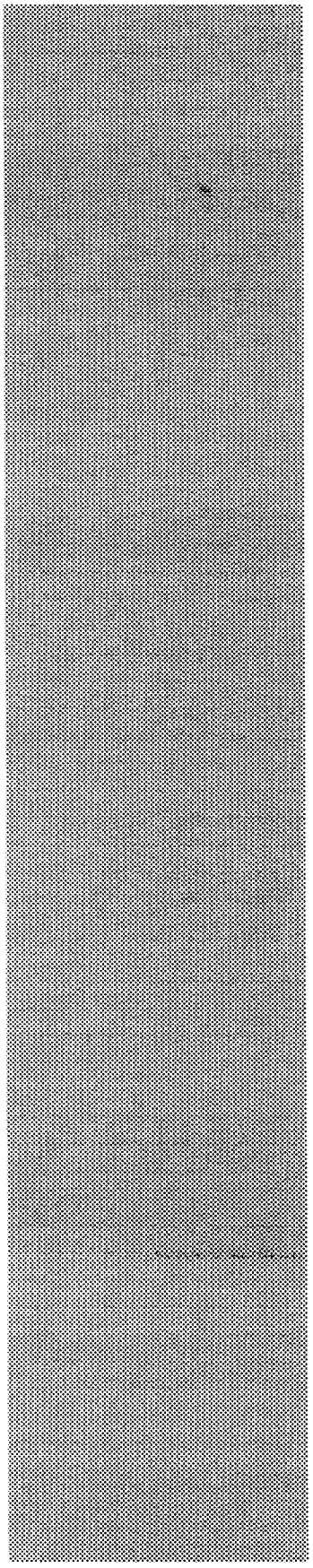
If a short circuit occurs in one of the inverters (e.g. THV1 and THV2 ignited), this is automatically quenched by the components L1, L2 and C5. In this case, C5 and L2 comprise an oscillator. The voltage across C5 then reverses polarity and drives a current across the inverse current diodes. This causes the thyristors to go dead, so that they can extinguish.

L1, together with the Intermediate Circuit capacitors, also comprises an oscillator, but with a much longer period of oscillation. This decouples the inverter from the Intermediate Circuit for the duration of the quenching process.

V4 and R1 limit the voltage across C5 and the inverters.

A short circuit is detected by measurement of the Intermediate Circuit voltage. If the voltage falls below 40 V, the signal N_BKETSE is generated. To prevent thermal overloading, all thyristors are first ignited and the inverters are then disabled for 10 ms. The resistors 0R002 between the thyristors symmetrize the on-state resistors, permitting uniform current distribution.


SMP-
Bus
Interface
CPU
D210 Host
Ctrl Console
D200
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
Contr.
TxD
RxD
MPS
ZKV
P100
P101
ZKV
N BKE
XRAY
KV+ ACT
KV- ACT
KV ACT SUM
KV NOM
D211 Master
KV- ACT
KV+ ACT
D220 Filament
Ct.
R+
R-
UZUND+
UZUND-
W1
H1
U1
V1
T1
K1
UZUND-
W2
U2
V2
T2
T3
T4
+
-
ZKV
XRAY
KV NOM
KV ACT SUM
D240
KV
Con-
troller
U
F
Enable
A
D
D
A
Micro-
Contr.
Core
SINV OK
SINV
MPS
UZU
N BKE TSE
N ZREL
N SK
SKU
220V
0VL
K2
SK
+24V
K1
K2
SK
AP2
AP1
AP1
AP2
D241
DKV PLANI
D902 Iontomat



The kV Controller serves for the switching, control and monitoring of the x-ray tube voltage. It is in the form of an analog PI controller, with digital setting of the control parameters (hybrid controller).

The setpoint value and all other instructions are transmitted to the Microcontroller via the MPS serial interface. The setpoint value is transmitted via a DAC to the regulator. High-voltage dividers measure the actual value, which is then processed on board D220 (Filament Circuit). From there, it is transmitted to D240, where KV+_ACT and KV-_ ACT are added to form the sum value KV_ACT_Sum.

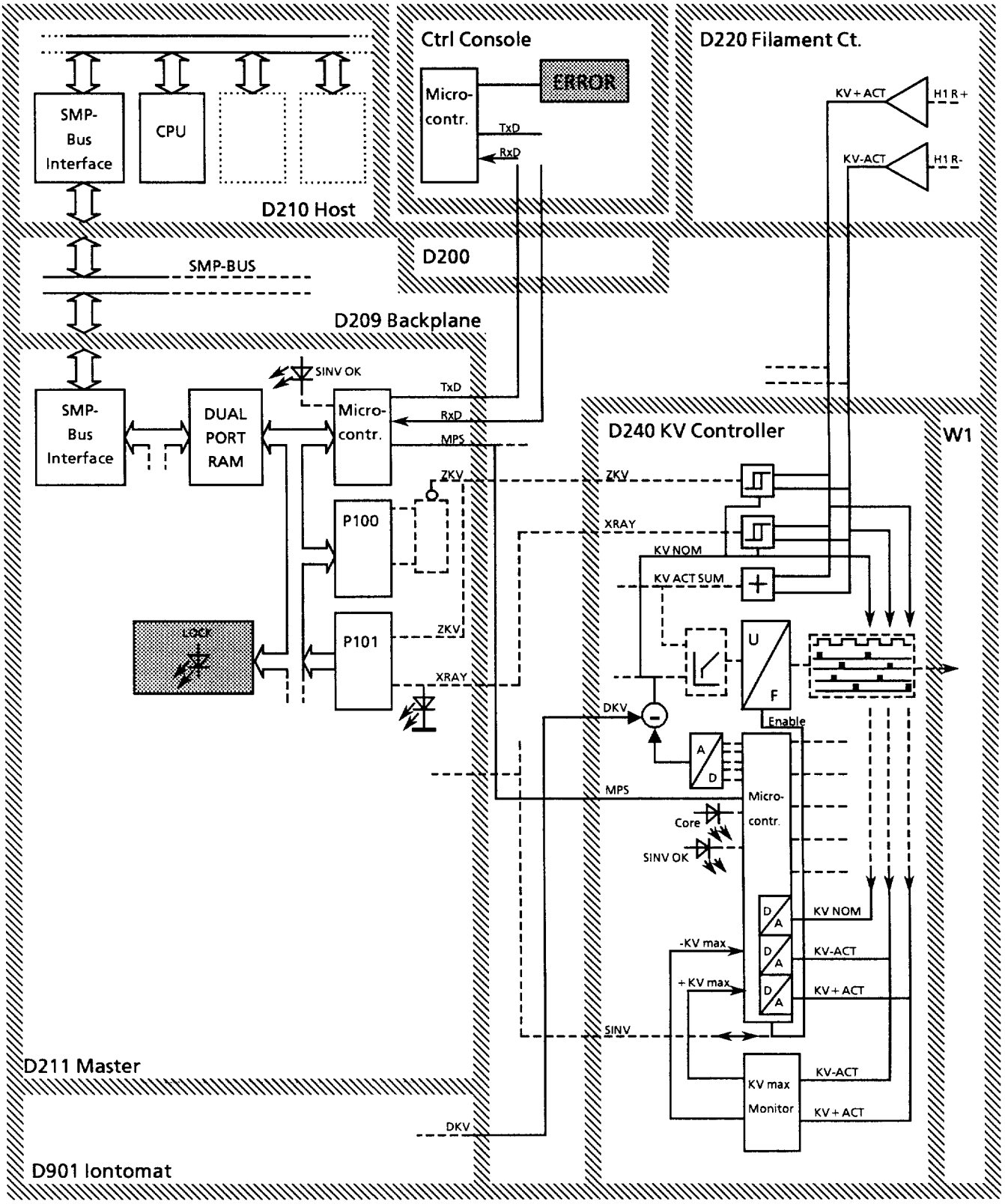
The variance comparison is then made and the difference value transmitted to the PI controller, which forms the analog actuating signal. Following this, a voltage frequency converter with the analog actuating signal as input generates an output signal with four times the inverter frequency. This signal is then distributed via a logic circuit to the four inverter bridge arms.

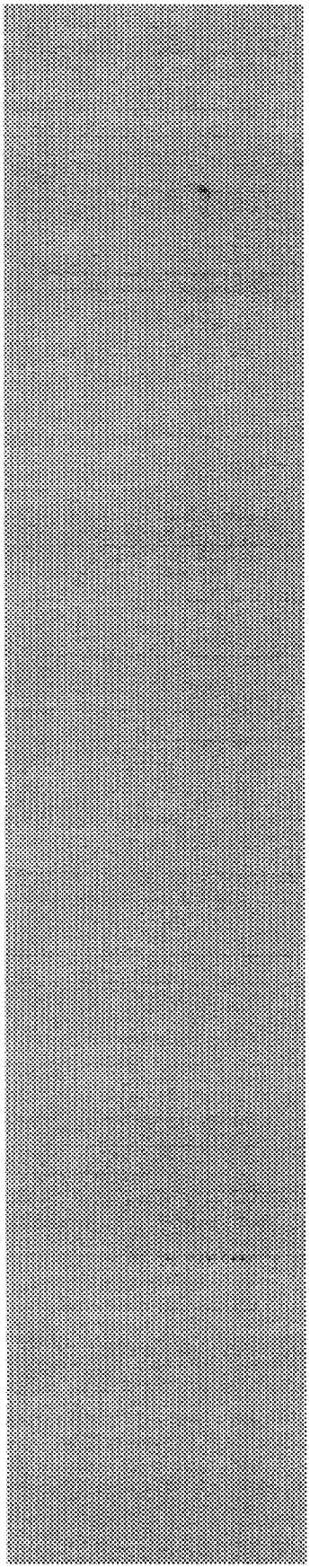
The mean value of the oscillation current, which is integrated by high-voltage capacitors on the secondary side of the High-voltage Transformer to generate the tube current, is determined by the control frequency.

Note:
For tomographic radiography with the automatic exposure control, the dose rate is regulated (Planiiontomat) by superimposing the voltage DKV onto the kV setpoint value to reduce the high voltage as required.

Control signals from the KV Controller:
N_ZREL..... switches on the ignition stage operating voltage
N_SK.....switches the oscillator at IRö ≥ 100mA
XRAY.....Radiation On (KV_{ACT} > 50% kV_{NOM}; LED indication on D211)
ZKV.....Two KV threshold for hardware disabling of workstation selection

Signals to the KV Contoller:
UZU.....Ignition voltage check signal
SKU.....Oscillator circuit switchover monitoring signal
N_BKE_TSE ..Intermediate Circuit voltage monitoring signal


Ctrl Console
Micro-contr.
ERROR
TxD
RxD
D220 Filament Ct.
KV+ACT
H1 R+
KV-ACT
H1 R-
SMP-Bus Interface
CPU
D210 Host
D200
SMP-BUS
D209 Backplane
SINV OK
TxD
RxD
MPS
SMP-Bus Interface
DUAL PORT RAM
Micro-contr.
D240 KV Controller
W1
ZKV
XRAY
KV NOM
KV ACT SUM
P100
P101
LOCK
U
F
DKV
Enable
A
D
MPS
Micro-contr.
Core
SINV OK
D
A
KV NOM
-KV max
KV-ACT
+KV max
KV+ACT
SINV
KV max Monitor
KV-ACT
KV+ACT
D211 Master
DKV
D901 Iontomat



The high-voltage monitoring checks that the actual values kV+_ACT and kV -_ACT are between the maximum and minimum permissible values.

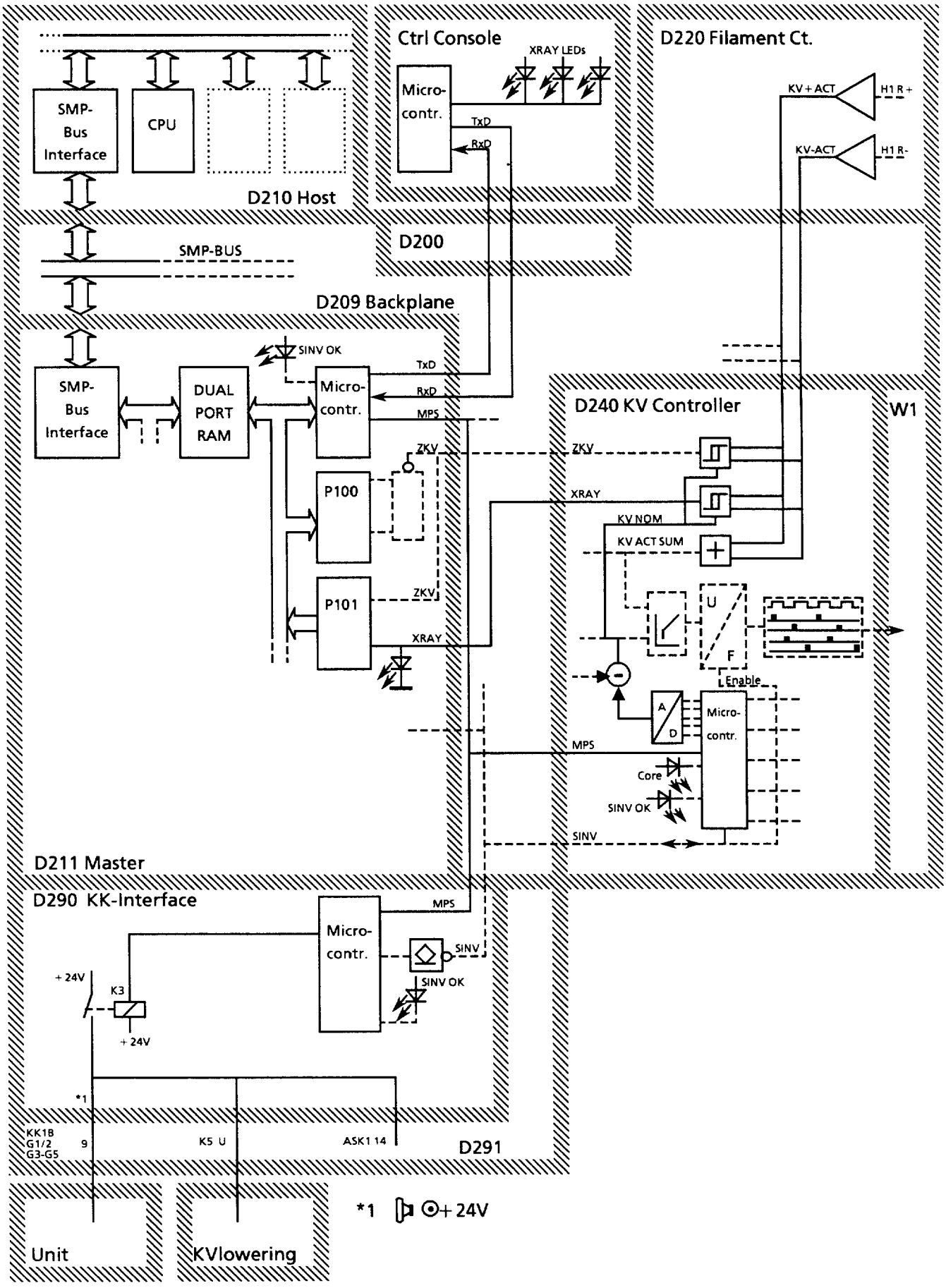
The kV_{MAX} monitoring (kV_{MAX} Monitor) takes place in the hardware. The response threshold is set to
90 kV for kV+ and for kV- , independently of tube type. Switch-off takes place with no delay.

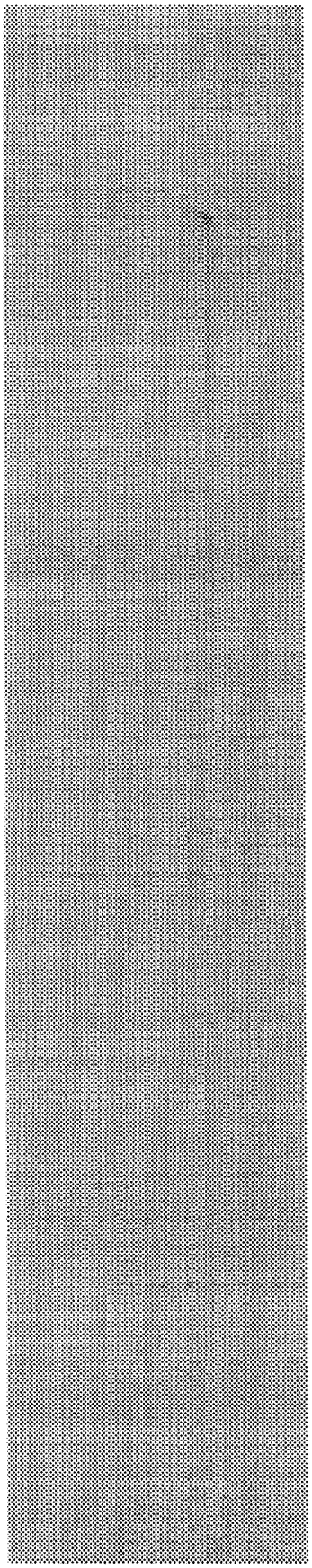
Checking with respect to the permissible minus deviation is performed by reading the actual values via ADC to the Microcontroller. The permissible deviation is (kV_{NOM}/2...20%)
– 7.5 kV for both the + and the – sides.

Momentary exceeding of the response threshold does not lead immediately to switch-off. Large deviations lead to disabling the high voltage after about 20 ms.

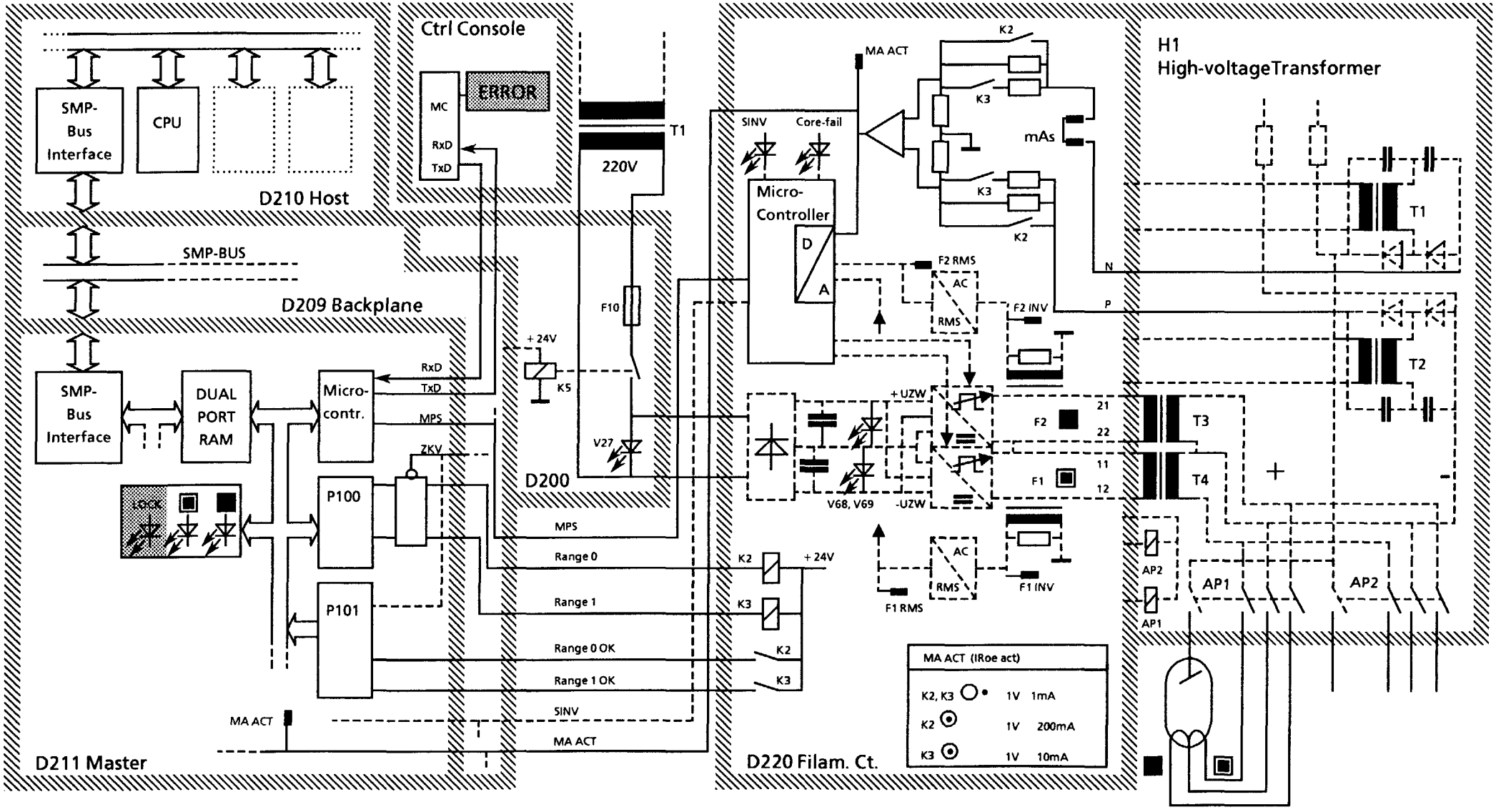
For tomographic radiography with automatic exposure controller, the Planiiontomat effects the kV setpoint value via the dose rate controller (DKV from D902). This means that the DKV-modified value, and not the kVsetpoint value, is used as the basis for comparison.

If one of the monitors responds, the high voltage is switched off via SINV. The origin of the fault is transmitted via the MPS to the Host Computer, which in turn generates the appropriate error message, displayed on the Control Console. The generator is then disabled, as shown by the red "LOCK" LED on D211 (Master board).


Ctrl Console
XRAY LEDs
Micro-contr.
TxD
RxD
D220 Filament Ct.
KV+ACT
H1 R+
KV-ACT
H1 R-
SMP-Bus Interface
CPU
D210 Host
D200
SMP-BUS
D209 Backplane
SINV OK
TxD
RxD
MPS
SMP-Bus Interface
DUAL PORT RAM
Micro-contr.
D240 KV Controller
W1
ZKV
XRAY
KV NOM
KV ACT SUM
P100
P101
ZKV
XRAY
U
F
Enable
A/D
Micro-contr.
MPS
Core
SINV OK
SINV
D211 Master
D290 KK-Interface
MPS
Micro-contr.
SINV
SINV OK
+24V
K3
+24V
*1
KK1B
G1/2
G3-G5
9
K5 U
ASK1 14
D291
Unit
KVlowering
*1 +24V



The XRAY signal is used for the Radiation Warning Indication. This signal is generated by the kV Controller when $kV_{ACT} > 50\%\ kV_{NOM}$. It remains On for a minimum time of 30 ms. It is indicated on the Service part of board D211 (Master). The signal is transmitted via port P101 from the Master board to the Host Computer, which in turn causes the Master board to transmit the signal "XRAY ON" via the MPS serial interface to the Control Console for visual display. The signal is available to the examination units at KK1B.9 for initiating exposure. K5.U controls the kV lowering and the tabletop travel for peripheral angiographiy. This signal is available at ASK1.14 for special purposes.


Ctrl Console
MC
ERROR
RxD
TxD
T1
220V
SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D209 Backplane
F10
+ 24V
K5
V27
D200
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
RxD
TxD
MPS
ZKV
Lock
P100
P101
MPS
Range 0
Range 1
Range 0 OK
Range 1 OK
SINV
MA ACT
MA ACT
D211 Master
SINV
Core-fail
MA ACT
K2
K3
mAs
Micro-
Controller
D
A
F2 RMS
AC
RMS
F2 INV
N
P
+UZW
F2
21
22
T3
T4
F1
11
12
V68, V69
-UZW
K2
+ 24V
K3
AC
RMS
F1 RMS
F1 INV
AP2
AP1
AP1
AP2
H1
High-voltageTransformer
T1
T2
MA ACT (IRoe act)
K2, K3
1V 1mA
K2
1V 200mA
K3
1V 10mA
D220 Filam. Ct.

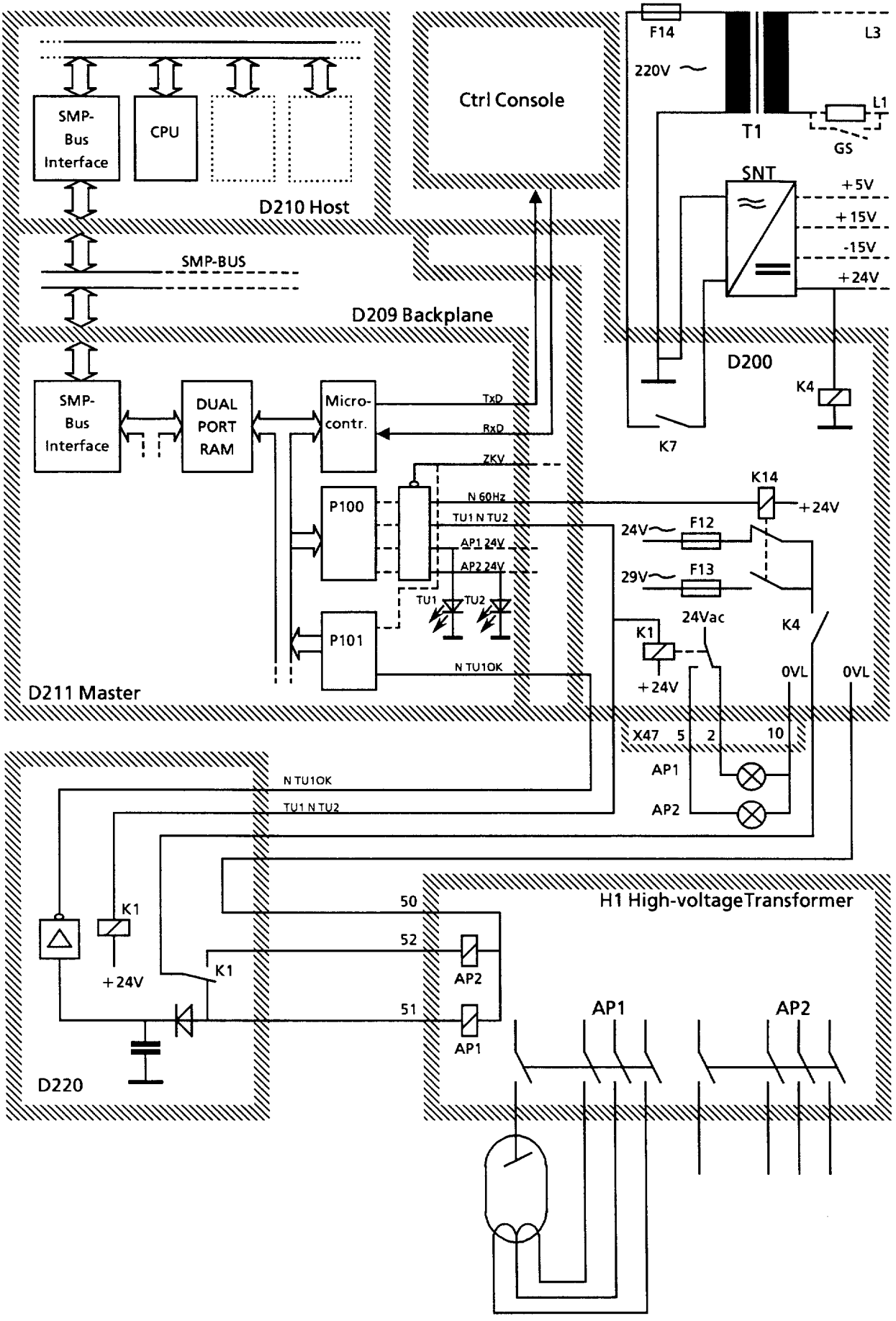
The mA measurement circuit is on board D220. It is connected via terminals N and P to the high voltage generation circuit. A voltage proportional to the tube current is produced at the ground-balanced multipliers; it is decoupled free of interference by a differential amplifier.

Three different measurement ranges are used for measuring the tube current:

Fluoroscopy:	1 V	1 mA
HC fluoroscopy:	1 V	10 mA
Radiography:	1 V	200 mA

The Host Computer selects the measurement ranges, according to generator operating mode. Switch-over takes place via the relays K2 and K3, which are controlled by the signals Range 0 and Range 1. Range 0 and Range 1 are output via port P100 on D211 (Master). Additional contacts on relays K2 and K3 ensure the monitoring of this function, by transmitting the signals Range 0_OK and Range 1_OK via port P101 (Master) to the Host Computer. The detection of a fault causes disabling of the generator and an appropriate error message to appear.

Oscillographic checking of the tube current is possible at test points X18.A4 (MA_ACT) on D220 and X14 (MA_ACT) in the measurement and display field on board D211. mAs measurements are possible at the MAS test jacks on board D220.


SMP-
Bus
Interface
CPU
D210 Host
Ctrl Console
F14
L3
220V
L1
T1
GS
SNT
+5V
+15V
-15V
+24V
SMP-BUS
D209 Backplane
D200
K4
K7
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
TxD
RxD
ZKV
K14
P100
N 60Hz
TU1 N TU2
+24V
24V
F12
AP1 24V
AP2 24V
29V
F13
TU1
TU2
24Vac
K4
K1
P101
N TU1OK
+24V
0VL
0VL
D211 Master
X47
5
2
10
AP1
AP2
N TU1OK
TU1 N TU2
K1
50
H1 High-voltageTransformer
52
AP2
+24V
K1
51
AP1
AP1
AP2
D220

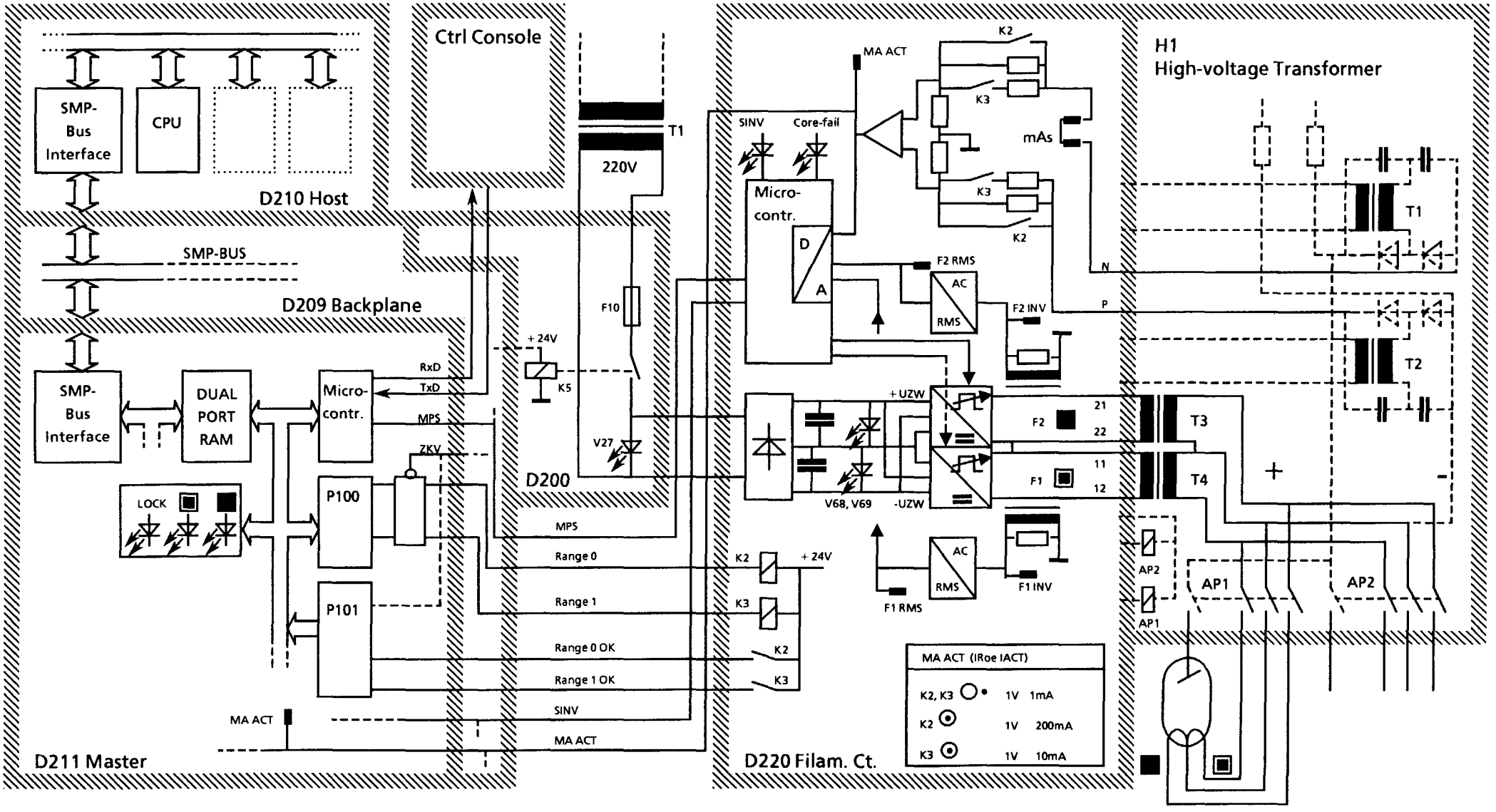
Workstation selection takes place from the Control Console. The assignment of the tubes to the workstations is defined in the system configuration. The Host Computer accesses these assignments via the EEPROMS. The control signal TU1_N_TU2 is output via the parallel port P100 on the Master board. TU1_N_TU2 controls the relay K1 on D220 and thus the switching of the workstation contactors AP1 and AP2 in the High-voltage Transformer. These contactors are controlled by an AC voltage. It is therefore necessary to switch the voltage according to line frequency via K14 (D200), with the signal N_60 Hz.

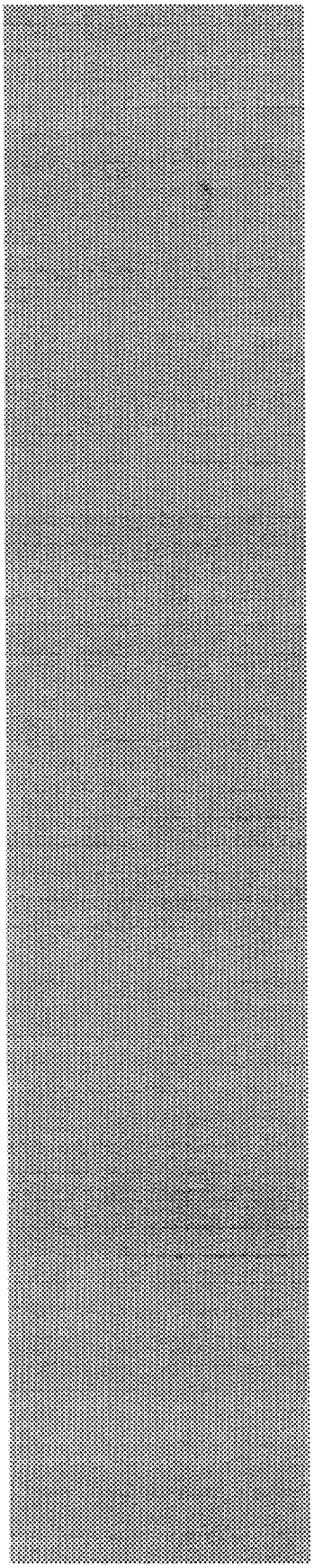
The workstation selection is hardware disabled with the signal ZKV (two KV threshold).

The workstation selection function is monitored and read back with the signal N_TU1_OK.

For servicing purposes, there are two correspondingly labelled LEDs on D211.

An external workstation indicator is also possible. Via K1 (D200), a 24 VAC signal is transmitted to connection X47, D200. A maximum current of 500 mA is available here for an external indicator system.


SMP-
Bus
Interface
CPU
D210 Host
Ctrl Console
T1
220V
SMP-BUS
D209 Backplane
F10
+ 24V
K5
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
RxD
TxD
MPS
ZKV
D200
V27
LOCK
P100
P101
MPS
Range 0
Range 1
Range 0 OK
Range 1 OK
SINV
MA ACT
MA ACT
D211 Master
SINV
Core-fail
Micro-
contr.
D
A
MA ACT
K2
K3
mAs
K3
K2
F2 RMS
AC
RMS
F2 INV
N
P
+UZW
-UZW
V68, V69
F2
21
22
F1
11
12
K2
K3
+ 24V
AC
RMS
F1 RMS
F1 INV
MA ACT (IRoe IACT)
K2, K3 1V 1mA
K2 1V 200mA
K3 1V 10mA
D220 Filam. Ct.
H1
High-voltage Transformer
T1
T2
T3
T4
+
-
AP2
AP1
AP1
AP2



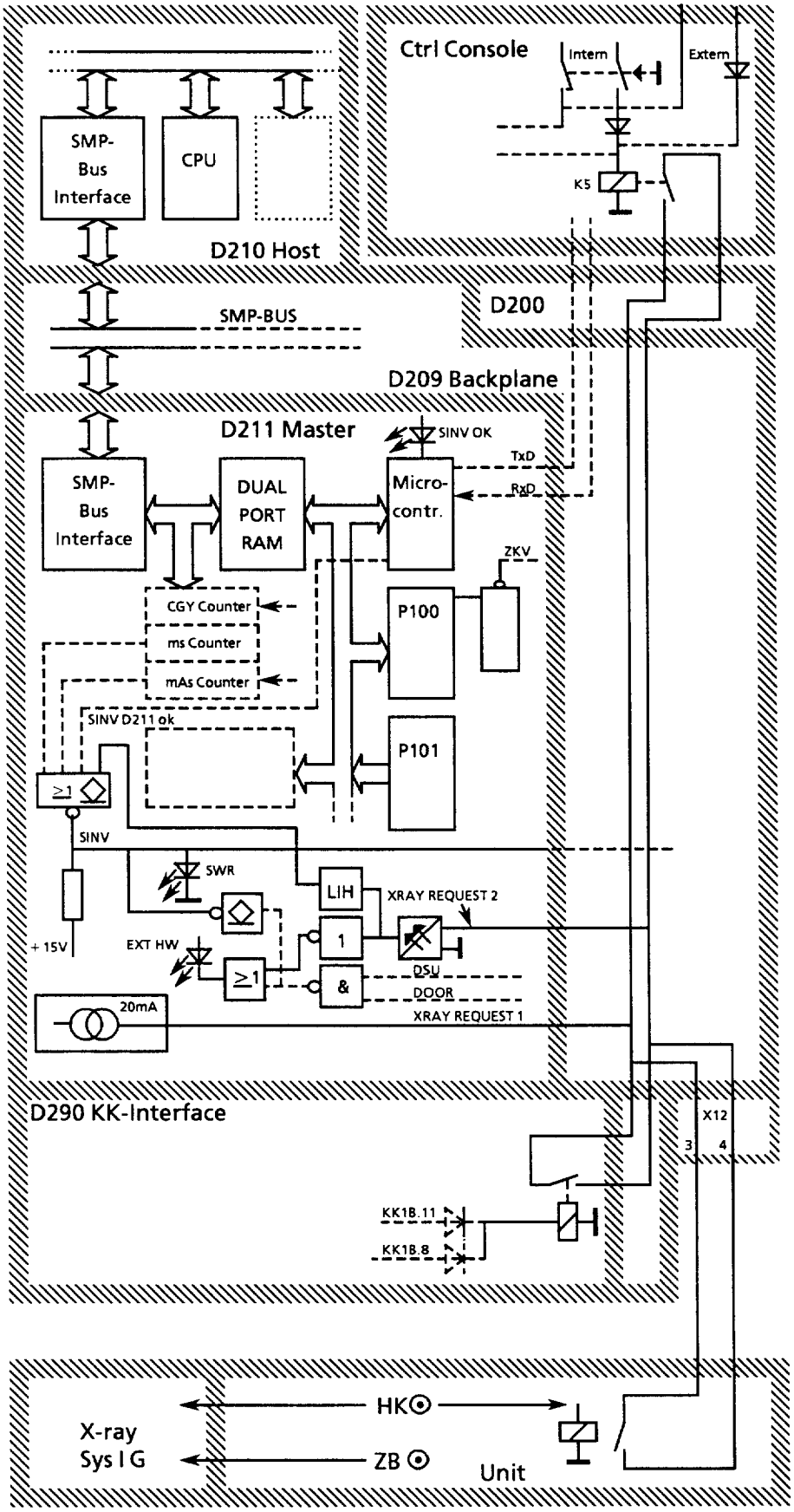
Two independent inverters are used to generate the filament current. These are configured with the SIPMOS transistors in a half bridge circuit as a square wave inverter, in which +UZW and -UZW are alternately switched to UZW/2. The current waveform results from the delay effect of the filament transformer inductivity. The inverter is controlled by a constant frequency of about 20 kHz, with variable pulse width (pulse width control).

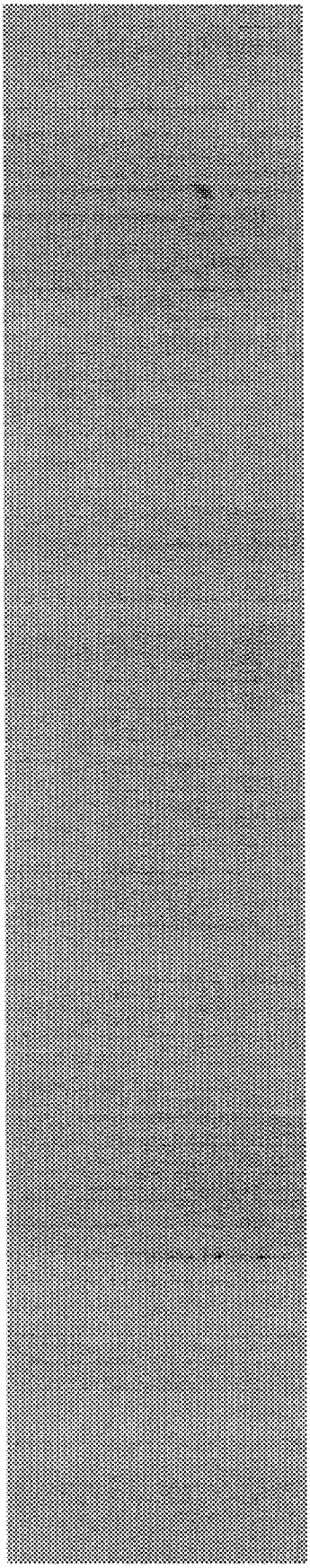
The generator p supplies the Intermediate Circuit voltage via relay K5 on D200 (fuse F10; indicator LED V27). This voltage is transmitted to the inverters following rectification and smoothing (indicated by V88 and V89 on D220).

The filament and tube current regulation is in the form of a PI controller in the Microcontroller system. The MPS serial interface transmits the setpoint values and all other information to the Microcontroller system.

A current transformer samples the filament current for control and monitoring. Via RMS/DC converters, a DC voltage proportional to the RMS value of the filament current is generated. This is transmitted via an ADC to the Microcontroller. Following a variance comparison and calculation by an appropriate algorithm, the actuating signal for the pulse width control of the inverters is generated here.

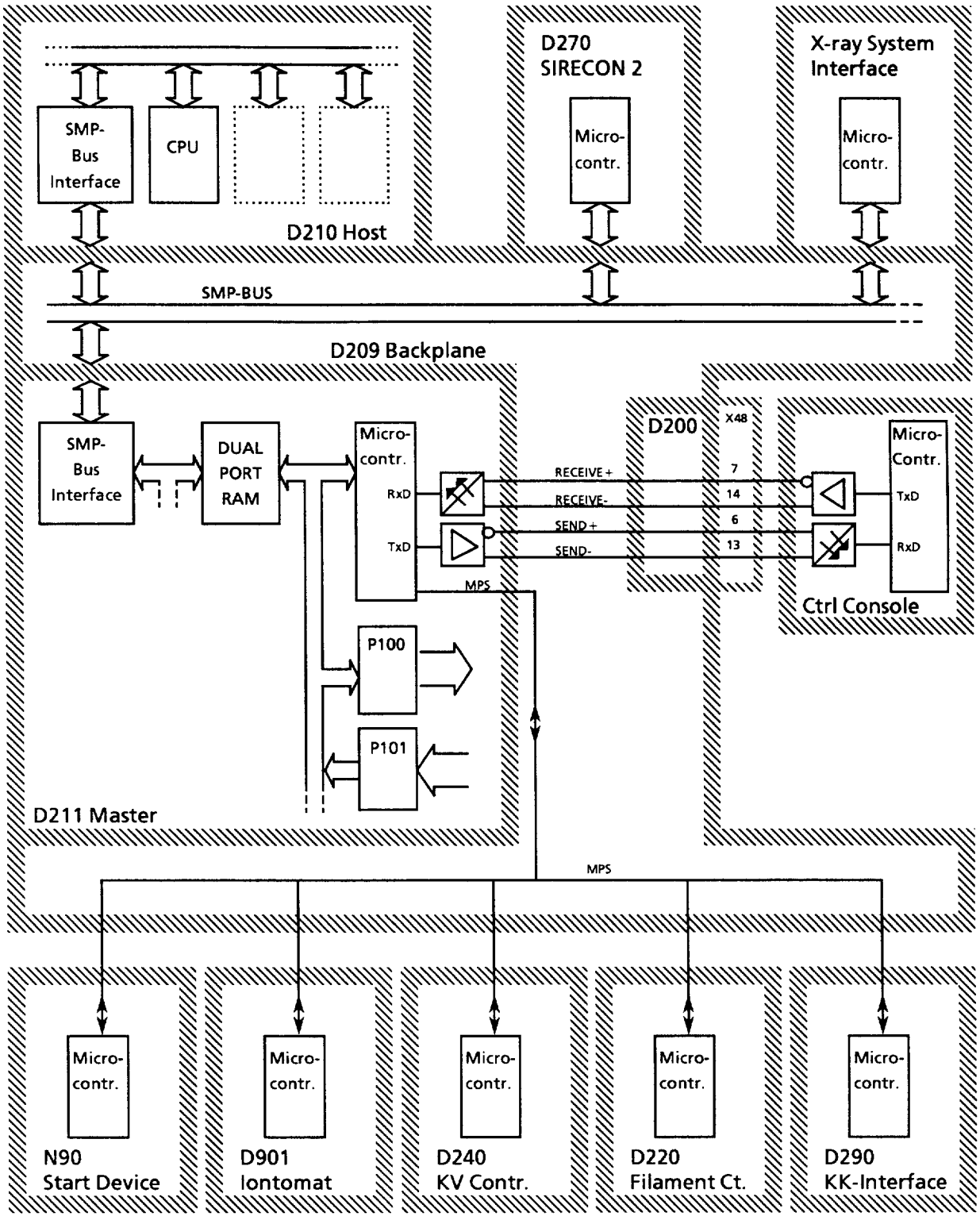
Switch-over from filament current control to tube current control takes place after the cable charge has decayed. Following a variance comparison and calculation by an appropriate algorithm, the corrective signal for the pulse width control of the filament inverter is generated here.


Ctrl Console
Intern
Extern
K5
SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D200
D209 Backplane
D211 Master
SINV OK
TxD
RxD
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
ZKV
CGY Counter
ms Counter
mAs Counter
P100
SINV D211 ok
P101
≥1
SINV
SWR
LIH
XRAY REQUEST 2
+ 15V
EXT HW
1
≥1
&
DSU
DOOR
XRAY REQUEST 1
20mA
D290 KK-Interface
X12
3
4
KK1B.11
KK1B.8
HK
X-ray
Sys I G
ZB
Unit



In order to exclude the possibility of inadvertently releasing radiation in case of disturbances in the generator or system electronics, the generator is equipped with a Safety Circuit. Each radiation release requires first mechanically closing a 20 mA current loop via the signals XRAY_REQUEST 1 and _ XRAY_REQUEST 2. This takes place at the time of radiation release from the Control Console via relay K5, for radiation release or fluoroscopy from units with KK plugs, via K27 (D290) and, for systems with an X-ray System Interface, via a relay which must be present in the system. This can be connected at X12, D200.

For working from the Service panel, switches S1 (Fluoro Service) and S27 HK and relay K1,D211 (radiography) close the safety circuit.


SMP-
Bus
Interface
CPU
D210 Host
D270
SIRECON 2
Micro-
contr.
X-ray System
Interface
Micro-
contr.
SMP-BUS
D209 Backplane
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
RxD
TxD
MPS
P100
P101
D211 Master
RECEIVE+
RECEIVE-
SEND+
SEND-
D200
X48
7
14
6
13
Micro-
Contr.
TxD
RxD
Ctrl Console
MPS
Micro-
contr.
N90
Start Device
Micro-
contr.
D901
Iontomat
Micro-
contr.
D240
KV Contr.
Micro-
contr.
D220
Filament Ct.
Micro-
contr.
D290
KK-Interface

Communication between the Host Computer and the generator components requires three different systems:

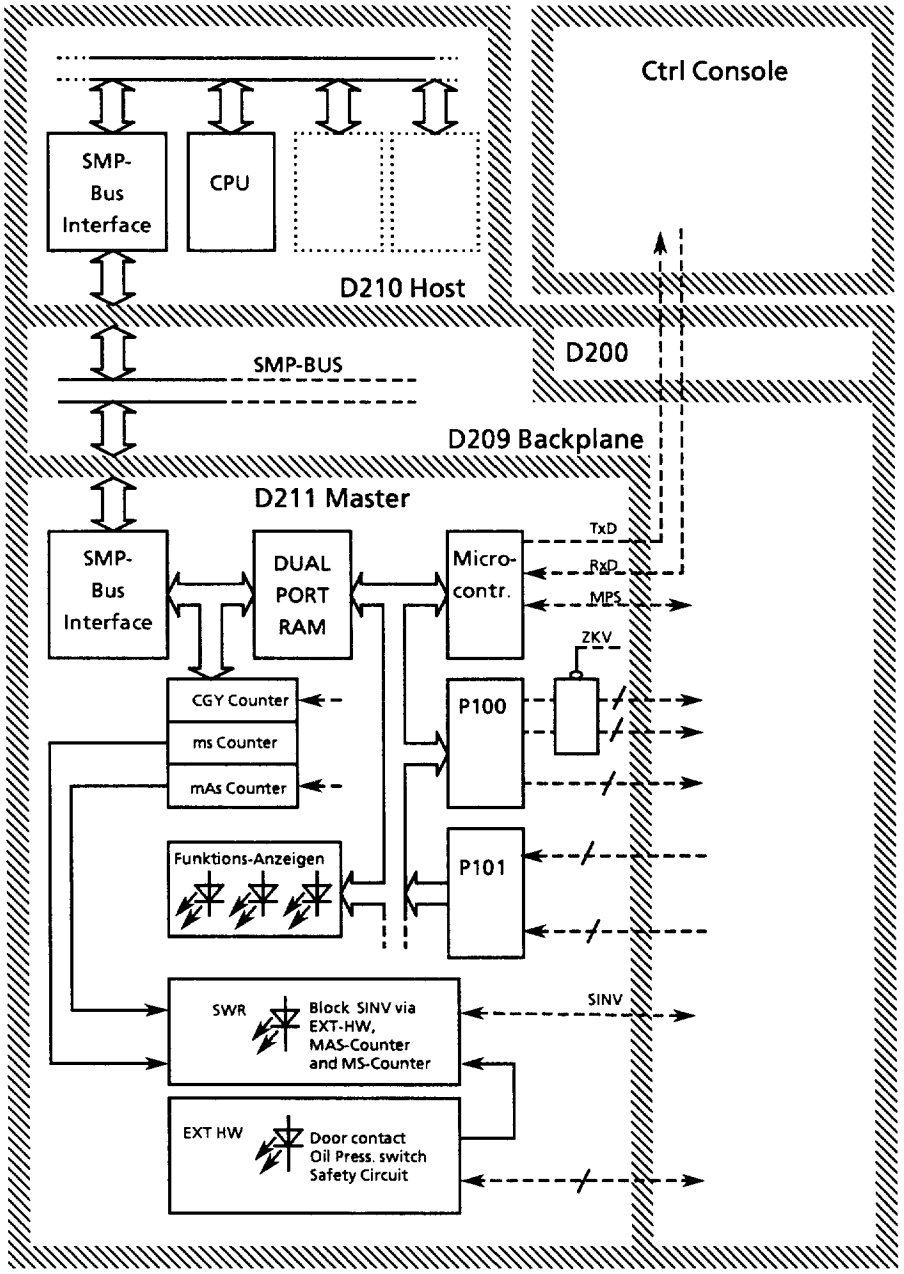
SMP - Bus
MPS
Hardware

The SMP - Bus is a 16 bit multiprocessor bus system, comprising the address data and control lines. It is located on the Backplane board (D 209). The SMP - Bus controls communication between the CPU (D 210, Host Computer), interface controller (D 211, Master board), Sirecon 2 interface (D 270) and the X-ray System Interface components.

The interface controller represents the link between the CPU and the generator components. It supervises the MPS serial communications line, which in turn controls communication between the CPU and the generator components.

Communication with the Control Console also takes place via the MPS. However, in order to ensure disturbance-free transmission, a current transmission is used.

There are also parallel input/output ports (P100, P101) on board D211. These serve to control and monitor various generator functions. Supervision of these ports is also under the control of the Master board.


Ctrl Console
SMP-
Bus
Interface
CPU
D210 Host
D200
SMP-BUS
D209 Backplane
D211 Master
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
TxD
RxD
MPS
ZKV
CGY Counter
ms Counter
mAs Counter
P100
Funktions-Anzeigen
P101
SWR
Block SINV via
EXT-HW,
MAS-Counter
and MS-Counter
SINV
EXT HW
Door contact
Oil Press. switch
Safety Circuit

Communication between the Host Computer and the generator components is under the control of board D211 (Master). Data exchange between the Host Computer and the Master board takes place via a Dual-Port RAM, controlled by the Master.

Sequence when Host sends data to Master:

- Host sends Request to RAM
- Master releases RAM control and signals release
- Host writes data into RAM and releases RAM control
- Master takes over RAM and evaluates data

Sequence when Master sends data to Host:

- Master writes data into RAM
- Master releases RAM control and signals new data
- Host takes data from RAM and releases RAM control
- Master takes back control of RAM

Two communication paths are used bewteeen the Master and the generator components:

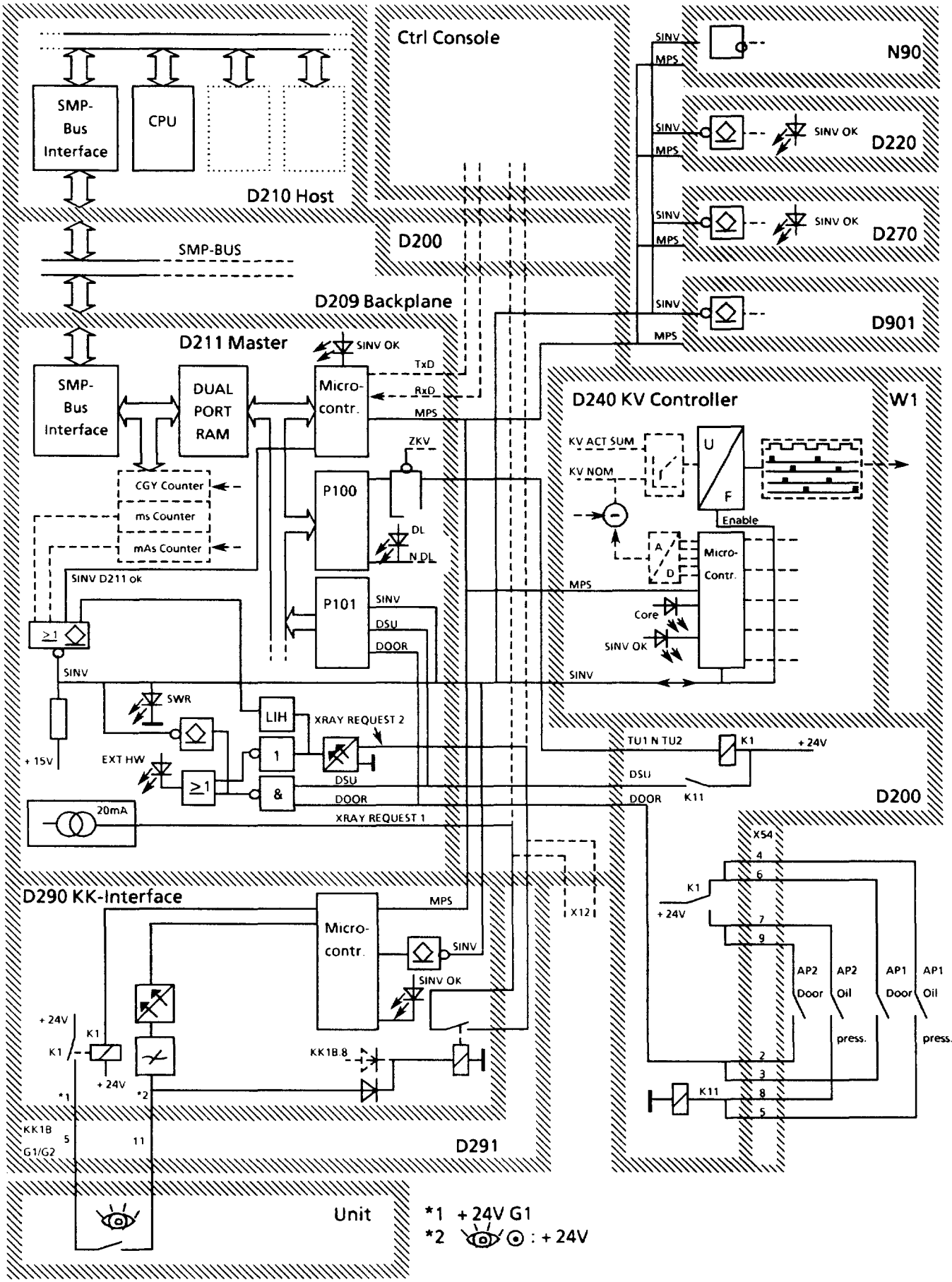
The MPS serial multiprocessor interface, enabling communication to the kV Controller, Filament Circuit, Iontomat, Starting Device N90, and KK-Interface, via a two-wire line. Communication with the Control Console is via a four-wire line.

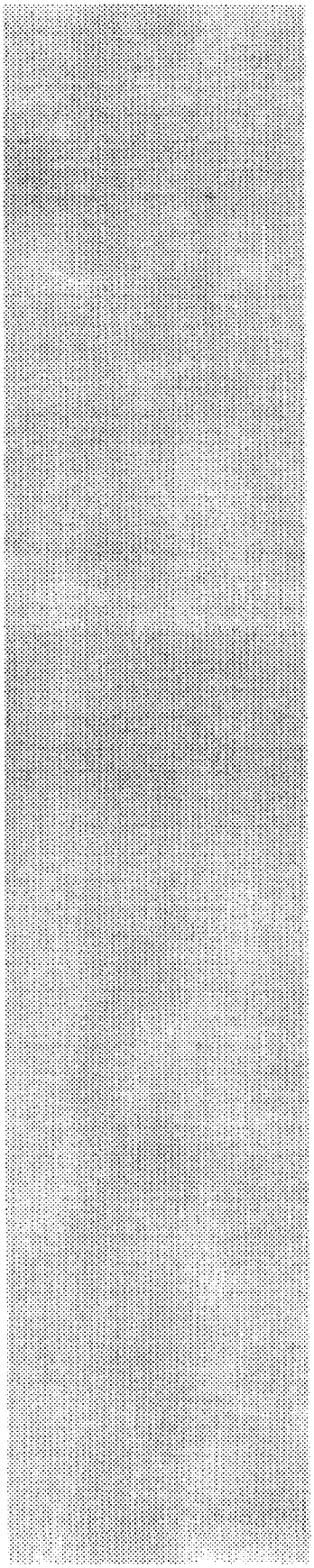
The parallel I/O ports, for controlling hardware, and their acknowledge messages.

There are also additional components and functions on board D211:

- mAs integrator (mAs Counter)
- Time limit monitoring (ms Counter)
- cGy * cm^2 Counter for Diamentor connection
- LEDs indicating important generator functions
- Test points for important analog parameters and control signals

The plug-in positions for the PALs required for the operation of various options are also found on D211.


Ctrl Console
SMP-
Bus
Interface
CPU
D210 Host
SMP-BUS
D209 Backplane
D211 Master
SMP-
Bus
Interface
DUAL
PORT
RAM
Micro-
contr.
SINV OK
TxD
RxD
MPS
ZKV
CGY Counter
ms Counter
mAs Counter
P100
DL
N DL
SINV D211 ok
P101
SINV
DSU
DOOR
≥1
SINV
SWR
LIH
XRAY REQUEST 2
+ 15V
EXT HW
1
≥1
&
DSU
DOOR
20mA
XRAY REQUEST 1
D200
SINV
MPS
N90
SINV
MPS
SINV OK
D220
SINV
MPS
SINV OK
D270
SINV
MPS
D901
D240 KV Controller
W1
KV ACT SUM
KV NOM
U
F
Enable
A
D
Micro-
Contr.
MPS
Core
SINV OK
SINV
TU1 N TU2
K1
+ 24V
DSU
DOOR
K11
D200
X54
4
6
K1
+ 24V
7
9
AP2
Door
AP2
Oil
press.
AP1
Door
AP1
Oil
press.
2
3
K11
8
5
X12
D290 KK-Interface
Micro-
contr.
MPS
SINV
SINV OK
+ 24V
K1
K1
+ 24V
*1
*2
KK1B.8
KK1B
G1/G2
5
11
D291
Unit
*1 + 24V G1
*2 : + 24V

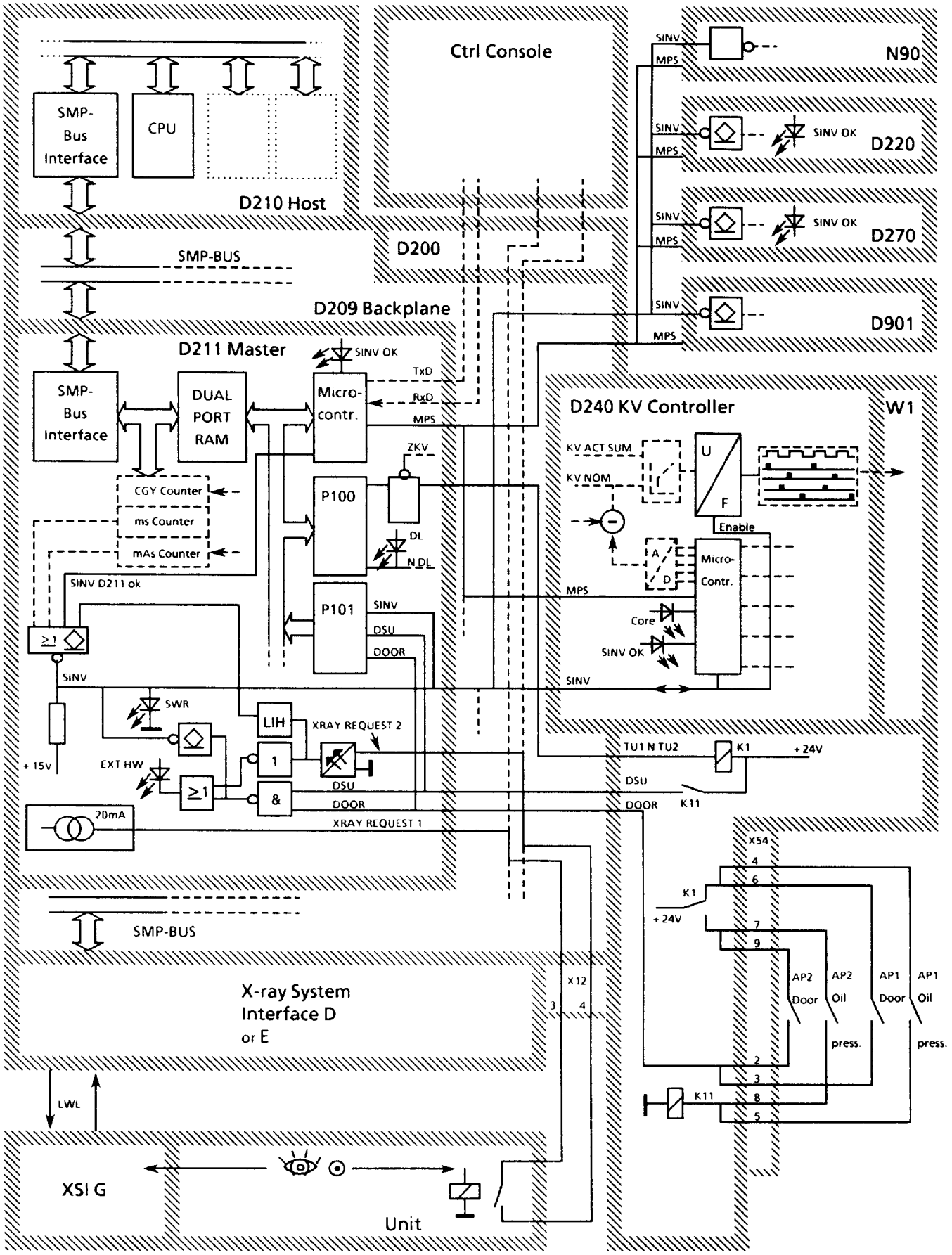


Following selection of the fluoroscopy unit, a +24 V control voltage is present on cable KK1b.5. Actuating the fluoroscopy release switch causes this voltage to be transmitted via KK1b.11 to the KK-Interface of the generator. Here, K27 closes the Safety Circuit. The control signal is filtered and passes via an opto-electronic separator to the interface controller. This controls the MPS, which transmits the Fluoro request to the Master board and on to the Host Computer.

The Host Computer performs all calculations and controls the signal processing. The information is then communicated to the Master board, which supplies the generator component Filament Circuit (D220), the starting device N90,
the Iontomat P (D901) and the kV Controller (D240) via the MPS with the required setpoint values and the command "Fluoro ON". The LED "FLUORO" on D211 lights up simultaneously.

The generator components then perform their tasks. As long as these tasks are correctly performed, the high voltage is switched on via the "SINV". This is controlled by the enabling of the voltage frequency converter on D240 (kV Controller), which generates the control signals for the inverter.

The software status of "SINV" is indicated for the individual components with LEDs. The Hardware - SINV signals combined by "wired OR" are indicated by the "SWR" LED on the Master board.


SMP-
Bus
Interface
CPU
D210 Host
Ctrl Console
SINV
MPS
N90
SINV OK
D220
D270
D901
SMP-BUS
D200
D209 Backplane
D211 Master
DUAL
PORT
RAM
Micro-
contr.
TxD
RxD
MPS
ZKV
P100
DL
NDL
P101
SINV
DSU
DOOR
CGY Counter
ms Counter
mAs Counter
SINV D211 ok
≥1
SWR
LIH
XRAY REQUEST 2
1
&
XRAY REQUEST 1
+ 15V
EXT HW
20mA
D240 KV Controller
W1
KV ACT SUM
KV NOM
U
I
F
Enable
A
D
Micro-
Contr.
Core
TU1 N TU2
K1
+ 24V
K11
X54
AP2
Door
AP2
Oil
press.
AP1
Door
AP1
Oil
press.
X12
X-ray System
Interface D
or E
LWL
XSI G
Unit

For selecting fluoroscopy from a unit which communicates via the X-ray System Interface with the generator, the internal processes in the generator are the same as when fluoroscopy is initiated via the KK-Interface. The only difference is the way in which the Fluoro Request signal is transmitted to the generator.

With communication via the X-ray System Interface, the unit sends a Fluoro Request signal via the interface to the generator, where the x-ray interface station of the generator receives the signal and transmits it to the Host Computer. The Host Computer then initiates all steps required to switch on fluoroscopy.

Independently of communication via the X-ray System Interface, the Safety Circuit for radiation release at the workstation selected must be closed.

TDF 1 / Flebbe
TDU 61 / Dr. McMinn